



CARLSON ENVIRONMENTAL, INC.

June 7, 1999

PN 9566C

Mr. John O'Grady  
Removal Project Manager  
Office of Superfund (SR-6J0))  
U.S. EPA Region 5  
77 West Jackson Boulevard  
Chicago, Illinois 60604

RE: QAPP Revisions  
Fansteel, Inc.  
Number One Tantalum Place  
North Chicago, Illinois

Dear Mr. O'Grady:

The revisions to the Quality Assurance Project Plan (QAPP) prepared by Carlson Environmental, Inc. (CEI) for the above-referenced site are attached. The revisions are intended to address the comments and recommendations included in your letter to Mr. Clifton A. Lake dated May 6, 1999. In addition, due to recent staff changes, Ms. Valerie Baxa has replaced Mr. Samuel Bodine as the QA Manager. Only the sections that have been revised are being submitted for review. A listing of the revisions is attached.

CEI is simultaneously submitting Great Lake Analytical's revisions to its Standard Operating Procedures (SOPs), under separate cover.

Please feel free to contact me at (312) 704-8843 if you have any questions or comments as you review the enclosed materials.

Respectfully submitted,

CARLSON ENVIRONMENTAL, INC.

*Margaret M. Karolyi*

Margaret M. Karolyi, P.E.  
Senior Project Manager

cc: Mr. Jonathan Jackson, Fansteel  
Mr. Mark Steger, McBride, Baker & Coles

attachments

EPA Region 5 Records Ctr.



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## CARLSON ENVIRONMENTAL, INC.

### CEI QAPP Revisions

Fansteel, Inc., North Chicago, Illinois

*The following revised sections of the QAPP prepared by CEI are attached and listed below. These revisions are included in the revised Quality Assurance Project Plan, Revised Version 1.1, Dated June, 1999.*

#### Signature Page

#### Report Text for Sections:

- 2.2 and 2.3
- 3.0 and 3.1.3
- 5.1 (page 3 of 4)
- 9.2
- 10.2.2.1

#### Appendix A:-

- Figure Two (Project Organization Diagram)

#### Appendix B:-

- Table One
- Table Two
- Table Five
- Table Six
- Table Seven

#### Appendix C:-

- List of SOPs
- FW-S-001 (Soil Sampling - GeoProbe)
- FW-C-004 (Sediment Sampling)
- FW-C-011 (Field Sample Collection for Method 5035)
- FW-E-003 (QED FC4000 - Use and Calibration)
- FW-R-003 (Chain of Custody Procedures)
- FW-Q-005 (Data Validation)

CEI notes that PCBs (including all aroclors referenced in Tables Five and Seven) have been added to the scope of work in the Site Investigation Work Plan, as a potential compound of concern in the soil and ground water.



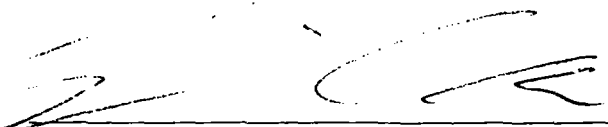
CARLSON ENVIRONMENTAL, INC.

## QUALITY ASSURANCE PROJECT PLAN

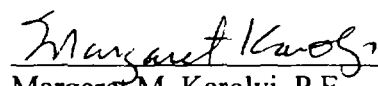
for the Site Investigation at:

Fansteel, Inc.  
One Tantalum Place  
North Chicago, Illinois

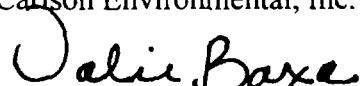
Prepared by  
CARLSON ENVIRONMENTAL, INC.

  
\_\_\_\_\_  
Edward E. Garske, CHMM  
Carlson Environmental, Inc. Project Director

6-7-99  
\_\_\_\_\_  
Date

  
\_\_\_\_\_  
Margaret M. Karolyi, P.E.  
Carlson Environmental, Inc. Project Manager

6/7/99  
\_\_\_\_\_  
Date

  
\_\_\_\_\_  
Valerie A. Baxa, CHMM  
Carlson Environmental, Inc. QA Manager

6-7-99  
\_\_\_\_\_  
Date

not applicable - refer to separate Great Lakes Quality Assurance Program  
Great Lakes QA Manager (if applicable)

\_\_\_\_\_  
Date

\_\_\_\_\_  
\_\_\_\_\_  
(printed name)  
State Project Manager (if applicable)

\_\_\_\_\_  
Date

\_\_\_\_\_  
John J. O'Grady  
U.S. EPA Region 5 Remedial Project Manager

\_\_\_\_\_  
Date

\_\_\_\_\_  
\_\_\_\_\_  
(printed name)  
U.S. EPA Region 5 Quality Assurance Reviewer

\_\_\_\_\_  
Date



## CARLSON ENVIRONMENTAL, INC.

*Quality Assurance Project Plan*  
(Revised Version 1.1 - June, 1999)  
Fansteel, Inc. - North Chicago, Illinois

Section 2.0  
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### 2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

**2.1 Project Organization Chart** - A project organization chart is included as Figure 2.1 in Appendix A of this *QAPP*. CEI is conducting the investigation on behalf of Fansteel, Inc., rather than as a contractor to the EPA. However, as shown in the project organization chart, CEI will correspond with Mr. John J. O'Grady, Remedial Project Manager for the Region V EPA, Superfund Division.

**2.2 Management Responsibilities** - CEI's project management team involved in developing the *Site Investigation Work Plan* and conducting investigations at the facility includes the following individuals:

- Project Director      Edward E. Garske, CHMM
- Project Manager      Margaret M. Karolyi, P.E.
- Project Engineer      Kenneth W. James, P.E.

Project Director - will have final responsibility and authority for all work performed. Mr. Garske will assure the resources required to successfully complete the project are committed.

Project Manager - is the key manager of project activities and is responsible for:

- Managing project operations and activities.
- Conducting technical review of each task being performed.
- Maintaining clear and effective communication with Fansteel's Project Manager.
- Working with Fansteel in project scoping and planning.
- Ensuring appropriate technical resources are utilized for each task.



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- Ensuring field activities are conducted in accordance with program Health and Safety and QA/QC requirements.
- Ensuring proper technical consultation is provided.
- Maintaining overall project technical continuity.
- Controlling costs and schedule aspects of all project activities.

Project Engineer - will be responsible for maintaining the quality of all engineering activities associated with the project in addition to establishing detailed task specifications including schedules and estimates of labor and material costs.

As indicated in the *HASP*, Lisa Meagher of CEI is designated as the Health & Safety Officer (HSO). Since only two to three CEI project personnel will be on site at any given time, for purposes of this project, the HSO will also function as the Site Supervisor. Margaret Karolyi and Bruce Shabino are assigned as designated alternates for the HSO/Site Supervisor position.

In addition to CEI's project management team, Mr. John J. O'Grady of U.S. EPA Region V will function as the Remedial Project Manager (RPM). The RPM has the overall responsibility for all phases of the Site Investigation.

### **2.3 Quality Assurance Responsibilities**

#### QA Manager

Samuel Bodine is designated as CEI's QA Manager. The QA manager will remain independent of direct job involvement and the day-to-day operations associated with this project, and have direct access to corporate executive staff as necessary, to resolve any QA dispute. Specific functions and duties include:

- Providing QA audit on various phases of the field operations;
- Reviewing and approving of QA plans and procedures;



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- Providing QA technical assistance to project staff;
- Review the sample results from the analytical laboratory for data validation purposes;
- Reporting on the adequacy, status, and effectiveness of the QA program on a regular basis to the Project Manager and the Project Director.

### QA Assurance Reviewer

U.S. EPA will appoint a QA Assurance Reviewer, who will have the responsibility to review and approve all QAPPs.

### **2.4 Field Responsibilities**

CEI Site Supervisor - CEI's Project Manager will be supported by the Site Supervisor (who will function as the field team leader). The Site Supervisor is responsible for leading and coordinating the day-to-day activities of the various workers and contractors under his/her supervision. Specific field team leader responsibilities include:

- Provision of day-to-day coordination with the project manager and project engineer on technical issues in specific areas of expertise;
- Developing and implementing of field-related work plans, assurance of schedule compliance, and adherence to management-developed study requirements;
- Coordinating and managing of field staff including sampling, drilling, and supervising field laboratory staff;
- Acting as field sample custodian;
- Implementing of QC for technical data provided by the field staff including field measurement data;
- Authoring, writing, and approving of text and graphics required for field team efforts;



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### 3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT

The overall QA objective for this project is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide results which are legally defensible in a court of law. Specific procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal quality control, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this *QAPP* and GLA's *Quality Assurance Program*, as referenced. CEI SOP FW-E-003 includes the guidance for collecting field measurements of pH, temperature and conductivity.

#### 3.1 Precision

3.1.1 Definition - Precision is a measure of the degree to which two or more measurements are in agreement.

3.1.2 Field Precision Objectives - Field precision is assessed through the collection and measurement of field duplicates at a rate of 1 duplicate per 10 analytical samples. The total number of duplicates planned for this project are found in Table One in Appendix B.

3.1.3 Laboratory Precision Objectives - Precision in the laboratory is assessed through the calculation of relative percent differences (RPD) and relative standard deviations (RSD) for three or more replicate samples. The equations to be used for precision in this project can be found in Section 8.6 of the GLA *Quality Assurance Program*. Precision control limits are discussed in Section 8.6 of the GLA *Quality Assurance Program* and are provided in the GLA SOPs.



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The site-specific sample number should consist of the following for soil, sediment and ground water samples:

- An alphanumeric designation indicating the sample location (i.e., GP-1 for soil boring number 1, MW-2 for monitoring well number 2, SED-1 for sediment sample location number 1, etc.);
- A letter designation corresponding to the sample depth. This letter designation would only apply to soil and sediment samples for this project (i.e., GP-1A for the shallowest soil sample collected from soil boring 1);
- The suffix -DUP for field duplicate samples (i.e., GP-14A-DUP).

The site-specific sample number should consist of the following for field blank and trip blank samples:

- A letter designation as to the type of blank sample (i.e., FB- for field blank and TB- for trip blank);
- A numerical designation indicating the Julian day and year (i.e., FB-001-99 for the field blank collected on January 1, 1999).

**5.2 Laboratory Custody Procedures** - The laboratory custody procedures for sample receiving and log-in; sample storage and numbering; tracking during sample preparation and analysis; and storage of data are described in Section 6 of the GLA *Quality Assurance Program*.

**5.3 Final Evidence Files** - The final evidence file will be the central repository for all documents which constitute evidence relevant to sampling and analysis activities as described in this *QAPP*. CEI is the custodian of the evidence file and maintains the contents of evidence files for the site, including all relevant records; reports, logs, field logbooks,





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**9.2 Data Validation** - Data validation procedures shall be performed for both field and laboratory operations as described below.

**9.2.1 Procedures Used to Validate Field Data** - Procedures used to evaluate field data for this project primarily include checking for transcription errors and review of field logbooks, on the part of field crew members. This task will be the responsibility of the Site Supervisor. An additional review of the field data will be conducted by CEI's QA Manager, who did not participate in the collection of the actual field data. CEI's QA Manager will validate at least 20% of the data (refer to CEI SOP FW-Q-001).

**9.2.2 Procedures Used to Validate Lab Data** - CEI's QA Manager will review the laboratory deliverables to ensure that the sample chain-of-custody forms, analytical results, and QC summaries have been delivered. GLA will conduct the validation procedures outlined in Section 12 of the GLA *Quality Assurance Program* and in the corresponding laboratory SOPs.

**9.3 Data Reporting** - Data reporting procedures shall be carried out for field and laboratory operations as indicated below:

**9.3.1 Field Data Reporting** - Field data reporting shall be conducted principally through the transmission of report sheets containing tabulated results of all measurements made in the field, and documentation of all field calibration activities.

**9.3.2 Laboratory Data Reporting** - GLA will begin reporting the analytical laboratory results once the validation activities have been concluded. GLA's QA Manager will perform a final review of the report summaries and case narratives to determine whether the report meets project requirements. In addition to the record of chain-of-custody, the report format shall consist of the following:



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### 10.1.2 External Field Audits -

10.1.2.1 External Field Audit Responsibilities - External field audits may be conducted by the EPA Region 5.

10.1.2.2 External Field Audit Frequency - External field audits may be conducted any time during the field operations. These audits may or may not be announced and are at the discretion of the EPA Region 5.

10.1.2.3 Overview of External Field Audit Process - External field audits will be conducted according to the field activity information presented in the *QAPP*.

### **10.2 Laboratory Performance and Systems Audits -**

10.2.1 Internal Laboratory Audits - GLA performs internal audits, as outlined in Section 11 of the GLA *Quality Assurance Program*.

### 10.2.2 External Laboratory Audits -

10.2.2.1 External Lab Audit Responsibilities - An external audit may be conducted by EPA Region 5 and/or CEI.

10.2.2.2 External Lab Audit Frequency - An external lab audit may be conducted at least once prior to the initiation of the sampling and analysis activities. These audits may or may not be announced and are at the discretion of the EPA.

10.2.2.3 Overview of External Lab Audit Process - External lab audits will include (but not be limited to) review of laboratory analytical procedures, laboratory on-site audits, and/or submission of performance evaluation samples to the laboratory for analysis.

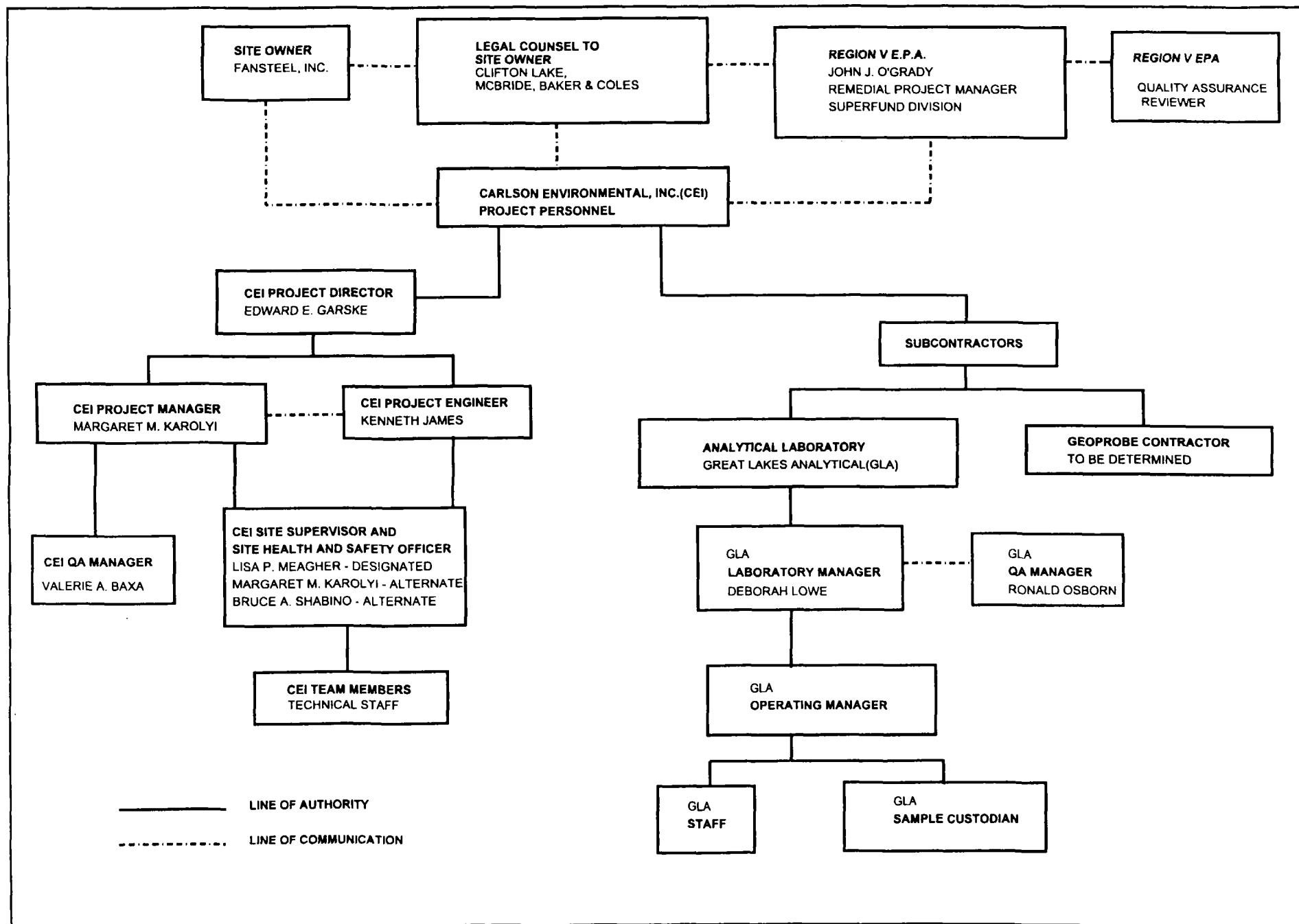


FIGURE 2: PROJECT ORGANIZATION DIAGRAM

**TABLE ONE: Site Investigation Sampling Summary**  
**Fansteel, Inc.**

Matrix	Parameter	EPA SW-846 Method	Sample Collection Points	Minimum Number of Samples	Number of Field Duplicates	MS/MSD Samples	Number and Type of Sample Containers	Preservation Method	Holding Time	Field Parameters
Soil	VOCs	5035/8260A	33 Borings	66 plus 25 from 0-12 inches	9	9	one 5g and one 25 g En Core Sample Container	Cool. Laboratory will handle samples in accordance with 5035 Methods	14 days	location, boring log, FID/PID reading, visual classification, note of obvious staining or odor
	Percent Moisture	7.3.3.1.5					one 4-oz glass jar	Cool	7 days	
	Pb, Cd, & Ta	3050/6010/7000		33 plus 25 from 0-12 inches	6	6	one 4-oz glass jar	Cool	6 months	
	SPLP Pb	1312/7421							28 days	
	pH	9045	Selected Soil Borings	5	0	0	one 4-oz glass jar	Cool	immediate	
	TOC	9060A							14 days	
Ground Water	VOCs	5030/8260A	9 Monitoring Wells	9	1	1	three glass 40-mL vials	Cool, HCl	14 days	location, conductivity, pH, temperature, water level
	Pb, Cd, & Ta	3001/3020/6010/7000 Series					two 500-mL plastic	Cool, HNO <sub>3</sub>	6 months	

**TABLE ONE: Site Investigation Sampling Summary**  
**Fansteel, Inc.**

Matrix	Parameter	EPA SW-846 Method	Sample Collection Points	Minimum Number of Samples	Number of Field Duplicates	MS/MSD Samples	Number and Type of Sample Containers	Preservation Method	Holding Time	Field Parameters	
Creek Sediment	VOCs	5035/ 8260A	7 Creek Bottom Locations, 2 Outfall Locations	18	2	2	one 5g and one 25 g En Core Sample Container	Cool. Laboratory will handle samples in accordance with 5035 Methods	14 days	location, presence of water, FID/PID reading, note of obvious odor or staining	
	Percent Moisture	7.3.3.1.5					one 4-oz glass jar	Cool	7 days		
	23 TAL Metals and Ta	3050/ 6010/ 7000 Series					one 4-oz glass jar	Cool	6 months (except Hg is 28 days)		
	SPLP Pb	1312/ 7421					one 4-oz glass jar	Cool	28 days		
	pH	9045							immediate		
	CN	9012							14 days		
	PNAs	8310					one 4-oz glass jar	Cool	14 days		
	PCBs	8082									
	Pesticides	8081									

**TABLE ONE: Site Investigation Sampling Summary**  
**Fansteel, Inc.**

Matrix	Parameter	EPA SW-846 Method	Sample Collection Points	Minimum Number of Samples	Number of Field Duplicates	MS/MSD Samples	Number and Type of Sample Containers	Preservation Method	Holding Time	Field Parameters	
Ditch Sediment	VOCs	5035/ 8260A	One Ditch Locaiton	2	1	1	one 5g and one 25 g En Core Sample Container	Cool. Laboratory will handle samples in accordance with 5035 Methods	14 days	location, presence of water, FID/PID reading, note of obvious odor or staining	
	Percent Moisture	7.3.3.1.5					one 4-oz glass jar	Cool	7 days		
	23 TAL Metals and Ta	3050/ 6010/ 7000 Series					one 4-oz glass jar	Cool	6 months (except Hg is 28 days)		
	SPLP Pb	1312/ 7421					one 4-oz glass jar	Cool	28 days		
	pH	9045							immediate		
	CN	9012							14 days		
	PNAs	8310					one 4-oz glass jar	Cool	14 days		
	PCBs	8082									

**TABLE ONE: Site Investigation Sampling Summary**  
**Fansteel, Inc.**

Matrix	Parameter	EPA SW-846 Method	Sample Collection Points	Minimum Number of Samples	Number of Field Duplicates	MS/MSD Samples	Number and Type of Sample Containers	Preservation Method	Holding Time	Field Parameters
Field Blanks (Water)	VOCs	5030/ 8260A	distilled water poured over a clean sampling instrument (e.g. split spoon or bailer)	One sample per day for each of the parameters that the samples collected on that day will also be analyzed for	N/A	N/A	40 mL vial	Cool. Laboratory will handle samples in accordance with 5035 Methods	14 days	N/A
	Pb, Cd, & Ta	3010/3020/ 6010/ 7000 Series			Note: do not submit sample if submitting 23 TAL Metals sample		two 500-mL plastic	Cool, HNO <sub>3</sub>	6 months	
	23 TAL Metals and Ta	3010/3020/ 6010/ 7000 Series			N/A	N/A			28 days	
	SPLP Pb	1312/ 7421								
	CN	9012					two 500-mL plastic	Cool		
	PCBs	8082								
	Pesticides	8081								
	PNAs	8310							1-L amber	

**TABLE ONE: Site Investigation Sampling Summary**  
**Fansteel, Inc.**

Matrix	Parameter	EPA SW-846 Method	Sample Collection Points	Minimum Number of Samples	Number of Field Duplicates	MS/MSD Samples	Number and Type of Sample Containers	Preservation Method	Holding Time	Field Parameters
Trip Blanks (Water)	VOCs	8260A	prepared by analytical laboratory using deionized water	One sample per day	N/A	N/A	40 mL vial	HCl	14 days	N/A



**TABLE TWO: Soil and Sediment Action Levels -VOCs**

**Fansteel, Inc.**

All concentrations are expressed in milligrams per kilogram (mg/kg)

ANALYTE	ACTION LEVEL <sup>1</sup>	REPORTING LIMIT <sup>2</sup>
Acetone	16	0.025
Benzene	0.03	0.005
Bromobenzene	detect	0.005
Bromochloromethane	detect	0.005
Bromodichloromethane	0.6	0.005
Bromoform	0.8	0.005
Bromomethane	detect	0.005
2-Butanone	detect	0.01
n-Butylbenzene	detect	0.005
sec-Butylbenzene	detect	0.005
tert-Butylbenzene	detect	0.005
Carbon disulfide	9	0.005
Carbon tetrachloride	0.07	0.005
Chlorobenzene	1	0.005
Chloroethane	detect	0.005
Chloroform	0.6	0.005
Chloromethane	detect	0.005
2-Chlorotoluene	detect	0.005
4-Chlorotoluene	detect	0.005
Dibromochloromethane	0.4	0.005
1,2-Dibromo-3-chloropropane	0.002	0.005
1,2-Dibromoethane	0.0004	0.005
Dibromomethane	detect	0.005
1,2-Dichlorobenzene	17.0	0.005
1,3-Dichlorobenzene	detect	0.005
1,4-Dichlorobenzene	2.0	0.005
Dichlorodifluoromethane	detect	0.005
1,1-Dichloroethane	23	0.005
1,2-Dichloroethane	0.02	0.005
1,1-Dichloroethene	0.06	0.005
cis-1,2-Dichloroethene	0.4	0.005
trans-1,2-Dichloroethene	0.7	0.005
1,2-Dichloropropane	0.03	0.005
1,3-Dichloropropane	0.004	0.005
2,2-Dichloropropane	detect	0.005
1,1-Dichloropropane	detect	0.005
cis-1,3-Dichloropropene	20 (sum of cis- and trans-)	0.005
trans-1,3-Dichloropropene		0.005
Diisopropyl ether	detect	0.005
Ethylbenzene	13	0.005
Hexachlorobutadiene	detect	0.005
2-Hexanone	detect	0.01
Isopropylbenzene	detect	0.005
4-Isopropyltoluene	detect	0.005
Methyl iodine	detect	0.005
Methylene chloride	0.02	0.005
4-Methyl-2-pentanone	detect	0.01

**TABLE TWO: Soil and Sediment Action Levels -VOCs****Fansteel, Inc.**

All concentrations are expressed in milligrams per kilogram (mg/kg)

ANALYTE	ACTION LEVEL <sup>1</sup>	REPORTING LIMIT <sup>2</sup>
Methyl-tert-butyl-ether	detect	0.005
Napthalene	84	0.005
n-Propylbenzene	detect	0.005
Styrene	4	0.005
1,1,1,2-Tetrachloroethane	detect	0.005
1,1,2,2-Tetrachloroethane	detect	0.005
Tetrachloroethene	0.06	0.005
Toluene	12	0.005
1,2,3-Trichlorobenzene	detect	0.005
1,2,4-Trichlorobenzene	5	0.005
1,1,1-Trichloroethane	2	0.005
1,1,2-Trichloroethane	0.02	0.005
Trichloroethene	0.06	0.005
Trichlorofluoromethane	detect	0.005
1,2,3-Trichloropropane	detect	0.005
1,1,2-Cl3-1,2,2-F3ethane	detect	0.005
1,2,4-Trimethylbenzene	detect	0.005
1,3,5-Trimethylbenzene	detect	0.005
Vinyl acetate	10.0	0.005
Vinyl chloride	0.01	0.005
Total xylenes	150	0.01

<sup>1</sup> Action Level represents the most stringent of the TACO Tier 1 remediation objectives for industrial/commercial properties with Class I ground water.

<sup>2</sup> Reporting Limit represents the analytical laboratory reporting limit (refer to GLA's QAPP for more information).

detect - Since a TACO Tier 1 remediation objective has not been established, the reporting limit will be applied as the action level.

**TABLE FIVE: Sediment Action Levels - PCBs/Pesticides****Fansteel, Inc.**

All concentrations are expressed in milligrams per kilogram (mg/kg).

ANALYTE	ACTION LEVEL <sup>1</sup>	REPORTING LIMIT <sup>2</sup>
Aldrin	0.3	0.0010
alpha-BHC	detect	0.0010
beta-BHC	detect	0.0010
delta-BHC	detect	0.0010
gamma-BHC (Lindane)	detect	0.0010
Chlordane	4	0.02
4,4'-DDD	16	0.0060
4,4'-DDE	17	0.0020
4,4'-DDT	17	0.0060
Dieldrin	0.0013	0.0020
Endosulfan I	18	0.0020
Endosulfan II	18	0.0020
Endosulfan sulfate	detect	0.0060
Endrin	1	0.0020
Endrin aldehyde	detect	0.0060
Heptachlor	detect	0.0010
Heptachlor epoxide	1	0.0010
Methoxychlor	160	0.02
Aroclor 1016	detect	0.025
Aroclor 1260	detect	0.025
Aroclor 1221 <sup>3</sup>	detect	0.025
Aroclor 1232 <sup>3</sup>	detect	0.025
Aroclor 1242 <sup>3</sup>	detect	0.025
Aroclor 1248 <sup>3</sup>	detect	0.025
Aroclor 1254 <sup>3</sup>	detect	0.025
Toxaphene	5.2	0.08

<sup>1</sup> Action Level represents the most stringent of the TACO Tier 1 remediation objectives for industrial/commercial properties with Class I ground water.

<sup>2</sup> Reporting Limit represents the analytical laboratory reporting limit (refer to GLA's QAPP for more information).

<sup>3</sup> This compound is a multi-component analyte. The limits for this analyte are based on the lowest concentration at which pattern recognition can be performed.

detect - Since a TACO Tier 1 remediation objective has not been established, the reporting limit will be applied as the action level.

**TABLE SIX: Ground Water Action Levels -VOCs****Fansteel, Inc.**

All concentrations are expressed in milligrams per liter (mg/L)

ANALYTE	ACTION LEVEL <sup>1</sup>	REPORTING LIMIT <sup>2</sup>
Acetone	0.7	0.01
Benzene	0.005	0.002
Bromobenzene	detect	0.002
Bromochloromethane	detect	0.002
Bromodichloromethane	0.00002	0.002
Bromoform	0.0002	0.002
Bromomethane	detect	0.002
2-Butanone	detect	0.01
n-Butylbenzene	detect	0.002
sec-Butylbenzene	detect	0.002
tert-Butylbenzene	detect	0.002
Carbon disulfide	0.7	0.002
Carbon tetrachloride	0.005	0.002
Chlorobenzene	0.1	0.002
Chloroethane	detect	0.002
Chloroform	0.00002	0.002
Chloromethane	detect	0.002
2-Chlorotoluene	detect	0.002
4-Chlorotoluene	detect	0.002
Dibromochloromethane	0.14	0.002
1,2-Dibromo-3-chloropropane	0.0002	0.002
1,2-Dibromoethane	0.00005	0.002
Dibromomethane	detect	0.002
1,2-Dichlorobenzene	0.6	0.002
1,3-Dichlorobenzene	detect	0.002
1,4-Dichlorobenzene	0.075	0.002
Dichlorodifluoromethane	detect	0.002
1,1-Dichloroethane	0.7	0.002
1,2-Dichloroethane	0.005	0.002
1,1-Dichloroethene	0.007	0.002
cis-1,2-Dichloroethene	0.07	0.002
trans-1,2-Dichloroethene	0.1	0.002
1,2-Dichloropropane	0.005	0.002
1,3-Dichloropropane	detect	0.002
2,2-Dichloropropane	detect	0.002
1,1-Dichloropropane	detect	0.002
cis-1,3-Dichloropropene	0.001	0.002
trans-1,3-Dichloropropene	(sum of cis- and trans-)	0.002
Diisopropyl ether	detect	0.002
Ethylbenzene	0.7	0.002
Hexachlorobutadiene	detect	0.002
2-Hexanone	detect	0.01
Isopropylbenzene	detect	0.002
4-Isopropyltoluene	detect	0.002
Methyl iodine	detect	0.002
Methylene chloride	0.005	0.002
4-Menthyl-2-pentanone	detect	0.01

**TABLE SIX: Ground Water Action Levels -VOCs****Fansteel, Inc.**

All concentrations are expressed in milligrams per liter (mg/L)

ANALYTE	ACTION LEVEL <sup>1</sup>	REPORTING LIMIT <sup>2</sup>
Methyl-tert-butyl ether	detect	0.002
Napthalene	0.0035	0.002
n-Propylbenzene	detect	0.002
Styrene	0.1	0.002
1,1,1,2-Tetrachloroethane	detect	0.002
1,1,2,2-Tetrachloroethane	detect	0.002
Tetrachloroethene	0.005	0.002
Toluene	1.0	0.002
1,2,3-Trichlorobenzene	detect	0.002
1,2,4-Trichlorobenzene	0.1	0.002
1,1,1-Trichloroethane	0.2	0.002
1,1,2-Trichloroethane	0.005	0.002
Trichloroethene	0.005	0.002
Trichlorofluoromethane	detect	0.002
1,2,3-Trichloropropane	detect	0.002
1,1,2-Cl3-1,2,2-F3ethane	detect	0.002
1,2,4-Trimethylbenzene	detect	0.002
1,3,5-Trimethylbenzene	detect	0.002
Vinyl acetate	7.0	0.01
Vinyl chloride	0.002	0.002
Total xylenes	detect	0.002

<sup>1</sup> Action Level represents the most stringent of the TACO Tier 1 remediation objectives for industrial/commercial properties with Class I ground water.

<sup>2</sup> Reporting Limit represents the analytical laboratory reporting limit (refer to GLA's QAPP for more information).

detect - Since a TACO Tier 1 remediation objective has not been established, the reporting limit will be applied as the action level.

**TABLE SEVEN: Ground Water Action Levels -TAL Metals/Ta/CN/PCBs**  
**Fansteel, Inc**

All concentrations are expressed in milligrams per liter (mg/L)

ANALYTE	ACTION LEVEL <sup>1</sup>	REPORTING LIMIT <sup>2</sup>
Aluminum	detect	0.20
Arsenic	0.05	0.050
Antimony	0.006	0.006
Barium	2	0.50
Beryllium	0.004	0.004
Cadmium	0.005	0.005
Calcium	detect	0.20
Chromium	0.1	0.010
Cobalt	1	0.050
Copper	0.65	0.050
Iron	5	0.050
Lead	0.0075	0.0075
Magnesium	detect	0.20
Manganese	0.15	0.050
Mercury	0.002	0.0020
Nickel	0.1	0.050
Aroclor 1016	detect	0.0005
Aroclor 1260	detect	0.0005
Aroclor 1221 <sup>3</sup>	detect	0.0005
Aroclor 1232 <sup>3</sup>	detect	0.0005
Aroclor 1242 <sup>3</sup>	detect	0.0005
Aroclor 1248 <sup>3</sup>	detect	0.0005
Aroclor 1254 <sup>3</sup>	detect	0.0005
Potassium	detect	0.20
Selenium	0.05	0.010
Silver	0.05	0.050
Sodium	detect	0.20
Tantalum	detect	0.50
Thallium	0.002	0.002
Vanadium	0.049	0.049
Zinc	5	0.50

<sup>1</sup> Action Level represents the most stringent of the TACO Tier 1 remediation objectives for industrial/commercial properties with Class I ground water.

<sup>2</sup> Reporting Limit represents the analytical laboratory reporting limit (refer to GLA's QAPP for more information).

<sup>3</sup> This compound is a multi-component analyte. The limits for this analyte are based on the lowest concentration at which pattern recognition can be performed.

detect - Since a TACO Tier 1 remediation objective has not been established, the reporting limit will be applied as the action level.

**List of SOPs submitted with QAPP**

Fansteel, Inc.  
North Chicago, Illinois

<b>SOP ID#</b>	<b>Name</b>	<b>Version</b>	<b>Revision Date</b>
FW- S- 001	Soil Sampling - General	2.0	October 22, 1998
FW- S- 005	Ground Water Monitoring Well Installation	2.0	October 19, 1998
FW- S- 006	Ground Water Monitoring Well Development	2.0	October 19, 1998
FW- S- 007	Sampling Equipment - Decontamination	2.0	November 18, 1998
FW- C- 004	Sediment Sampling	2.0	October 20, 1998
FW- C- 006	Ground Water Sampling - General	1.0	October 20, 1998
FW- C- 010	Disposal Sample Collection (from Drums)	2.0	November 18, 1998
FW- E- 003	QED FC4000 - Use and Calibration	1.0	June 1, 1998
FW- R- 001	Completing Soil Boring Logs	2.0	August 24, 1998
FW- R- 002	Completing Well Installation Logs	2.0	August 25, 1998
FW- R- 003	Chain-of-Custody Procedures	2.1	May 26, 1998
FW- Q- 005	Data Validation	1.0	June 1, 1999

# CEI STANDARD OPERATING PROCEDURES

## *Soil Sampling - General*

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SOP # FW-S-001

REVISION DATE: October 22, 1998

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### **1.0 Scope and Application**

The purpose of this standard operating procedure (SOP) is to describe the procedures for the collection of representative soil samples. Analysis of soil samples may determine whether concentrations of specific pollutants exceed established action levels, or if the concentrations of pollutants present a risk to public health, welfare, or the environment.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (EPA) or Carlson Environmental, Inc. (CEI) endorsement or recommendation for use.

### **2.0 Method Summary**

Soil samples may be collected using a variety of methods and equipment. The methods and equipment used are dependent on the depth of the desired sample, the type of sample required (disturbed vs. undisturbed), and the soil type. Near-surface soils may be easily sampled using a spade, trowel, and scoop. Sampling at greater depths may be performed using a hand auger, continuous flight auger, a trier, a split-spoon, or, if required, a backhoe.

### **3.0 Sample Preservation, Containers, Handling and Storage**

Chemical preservation of solids is not generally recommended. Samples should, however, be cooled and protected from sunlight to minimize any potential reaction.

If field preservation for VOCs is to be conducted in accordance with EPA Method 5035, please refer to CEI SOP # FW-C-011 for additional information.

### **4.0 Potential Problems**

There are two primary interferences or potential problems associated with soil sampling. These include cross contamination of samples and improper sample collection. Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Improper sample collection can involve using contaminated equipment, disturbance of the matrix resulting in compaction of the sample or inadequate homogenization of the samples where required, resulting in variable, non-representative results.

### **5.0 Equipment/Apparatus**

Soil sampling equipment includes the following:

- Sampling plan
- Maps/plot plan
- Safety equipment, as specified in the Health and Safety Plan
- Survey equipment
- Tape measure
- Survey stakes or flags
- Camera and film
- Stainless steel, plastic, or other appropriate homogenization bucket, bowl or pan
- Appropriate size sample containers
- Ziplock plastic bags
- Logbook
- Labels
- Chain of Custody records and seals
- Field data sheets
- Cooler(s)
- Ice
- Vermiculite
- Decontamination supplies/equipment
- Canvas or plastic sheet
- Spade or shovel
- Spatula
- Scoop
- Plastic or stainless steel spoons
- Trowel



# CEI STANDARD OPERATING PROCEDURES

## *Soil Sampling - General*

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- Continuous flight (screw) auger
- Bucket auger
- Post hole auger
- Extension rods
- T-handle
- 5-gram and 25-gram Encore™ Samplers
- Appropriate supplies for EPA Method 5035 analysis for VOCs
- Sampling trier
- Thin wall tube sampler
- Split spoons
- Vehimeyer soil sampler outfit
  - Points
  - Drive head
  - Drop hammer
  - Puller jack and grip
- Backhoe

### 6.0 Reagents

Reagents are not used for the preservation of soil samples. Decontamination solutions are specified in the Sampling Equipment Decontamination SOP # FW-S-007 and the site specific work plan.

### 7.0 PROCEDURES

#### 7.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies required.
2. Obtain necessary sampling and monitoring equipment.
3. Decontaminate or pre-clean equipment, and ensure that it is in working order.
4. Prepare schedules, and coordinate with staff, client, and regulatory agencies, if appropriate.
5. Perform a general site survey prior to site entry in accordance with the site specific Health and Safety Plan.
6. Use stakes, flagging, or buoys to identify and mark all sampling locations. Specific site factors,

including extent and nature of contaminant should be considered when selecting sample location. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. All staked locations will be utility-cleared by the property owner prior to soil sampling.

#### 7.2 Sample Collection

##### 7.2.1 Surface Soil Samples

Collection of samples from near-surface soil can be accomplished with tools such as spades, shovels, trowels, and scoops. Surface material can be removed to the required depth with this equipment, then a stainless steel or plastic scoop can be used to collect the sample.

This method can be used in most soil types but is limited to sampling near surface areas. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sample team member. A stainless steel scoop, lab spoon, or plastic spoon will suffice in most other applications. The use of a flat, pointed mason trowel to cut a block of the desired soil can be helpful when undisturbed profiles are required. Care should be exercised to avoid use of devices plated with chrome or other materials. Plating is particularly common with garden implements such as potting trowels. The following procedure is used to collect surface soil samples:

1. Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned spade.
2. Using a pre-cleaned, stainless steel scoop, plastic spoon, or trowel, remove and discard a thin layer of soil from the area which came in contact with the spade.
3. If volatile organic analysis is to be performed using Encore™ samplers, refer to Section 7.2.3.1. If volatile organic analysis is to be performed using field preservation with Method

# CEI STANDARD OPERATING PROCEDURES

## *Soil Sampling - General*

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5035, refer to SOP # FW-C-011. If method 5035 is not to be used and volatile organic analysis is to be performed using Method 8260, transfer the sample directly into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval or location into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

### 7.2.2 Sampling at Depth with Augers and Thin Wall Tube Samplers

This system consists of an auger, or a thin-wall tube sampler, a series of extensions, and a "T" handle. The auger is used to bore a hole to a desired sampling depth, and is then withdrawn. The sample may be collected directly from the auger. If a core sample is to be collected, the auger tip is then replaced with a thin wall tube sampler. The system is then lowered down the borehole, and driven into the soil to the completion depth. The system is withdrawn and the core is collected from the thin wall tube sampler.

Several types of augers are available; these include: bucket type, continuous flight (screw), and post-hole augers. Bucket type augers are better for direct sample recovery since they provide a large volume of sample in a short time. When continuous flight augers are used, the sample can be collected directly from the flights. The continuous flight augers are satisfactory for use when a composite of the complete soil column is desired. Post-hole augers have limited utility for sample collection as they are designed to cut through fibrous, rooted, swampy soil and cannot be used below a depth of three feet.

The following procedure will be used for collecting soil samples with the auger:

1. Attach the auger bit to a drill rod extension, and attach the "T" handle to the drill rod.
2. Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). It may be advisable to remove the first three to six inches of surface soil for an area approximately six inches in radius around the drilling location. After reaching the desired depth, slowly and carefully remove the auger from boring. When sampling directly from the auger, collect the sample after the auger is removed from the boring and proceed to Step 10.
3. Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods. It also facilitates refilling the hole, and avoids possible contamination of the surrounding area.
4. After reaching the desired depth, slowly and carefully remove the auger from boring. When sampling directly from the auger, collect the sample after the auger is removed from the boring and proceed to Step 10.
5. Remove auger tip from drill rods and replace with a pre-cleaned thin wall tube sampler. Install the proper cutting tip.
6. Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into soil. Care should be taken to avoid scraping the borehole sides. Avoid hammering the drill rods to facilitate coring as the vibrations may cause the boring walls to collapse.
7. Remove the tube sampler, and unscrew the drill rods.
8. Remove the cutting tip and the core from the device.

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### *Soil Sampling - General*

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9. Discard the top of the core (approximately 1 inch), as this possibly represents material collected before penetration of the layer of concern. Place the remaining core into the appropriate labeled sample container. Sample homogenization is not required.
10. If volatile organic analysis is to be performed using Encore™ samplers, refer to Section 7.2.3.1. If volatile organic analysis is to be performed using field preservation with Method 5035, refer to SOP # FW-C-011. If method 5035 is not to be used and volatile organic analysis is to be performed using Method 8260, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent, and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly.

When compositing is complete, place the sample into appropriate, labeled containers and sample into appropriate, labeled containers secure the caps tightly.

11. If another sample is to be collected in the same hole, but at a greater depth, reattach the auger bit to the drill and assembly, and follow steps 3 through 11, making sure to decontaminate the auger and tube sampler between samples.
12. Abandon the hole according to applicable State regulations. Generally, shallow holes can simply be backfilled with the removed soil material.

#### 7.2.3 Sampling at Depth with a Trier

The system consists of a trier, and a "T" handle. The auger is driven into the soil to be sampled and used to extract a core sample from the appropriate depth.

The following procedure will be used to collect soil samples with a sampling trier:

1. Insert the trier into the material to be sampled at a 0 to 45 angle from horizontal. This orientation minimizes the spillage of sample.
2. Rotate the trier once or twice to cut a core of material.
3. Slowly withdraw the trier, making sure that the slot is facing upward.
4. If volatile organic analysis is to be performed using Encore™ samplers, refer to Section 7.2.3.1. If volatile organic analysis is to be performed using field preservation with Method 5035, refer to SOP # FW-C-011. If method 5035 is not to be used and volatile-organic analysis is to be performed using Method 8260, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

#### 7.2.3.1 Encore™ Sampling with a Trier

This method should be used whenever volatile organic sampling is to be conducted using Encore™ samplers. The filled Encore™ samplers will be submitted to the laboratory. The laboratory will extract the sample from the Encore™ sampler and conduct the preservation required by Method 5035.

The Encore™ samplers come in two sizes - 5 gram and 25 gram. One sampler of each size should be used per desired sample interval. The Encore™

## CEI STANDARD OPERATING PROCEDURES

### *Soil Sampling - General*

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sampler comes from the laboratory in a sealed silver foil-type bag that is resealable.

1. Open the bag should and retrieve the two-piece sampler assembly.
2. Attach the plunger portion of the assembly to the trier dedicated to Encore™ sampling. This is achieved by pressing the spring mechanism down while loading the plunger assembly into the bottom of the trier.
3. Press the trier/assembly into the desired soil sample until the plunger mechanism becomes viewable in the viewing holes located on the trier. The lowest viewing hole corresponds to the 5-gram sampler and the highest viewing hole corresponds to the 25-gram sampler.
4. Cap the sampler and tighten the cap by screwing it clockwise. Press the spring mechanism to release the capped sampler from the trier.
5. Place the capped sampler in the foil-type bag it was removed from and re-seal the bag. Write the sample information on the label attached to the bag.
6. Place the bag in the sample cooler.

Note: A dry weight sample needs to be submitted with the Encore™ samplers, for laboratory analysis. This sample should be placed in a 2-ounce or 4-ounce glass jar and requires no preservative.

#### 7.2.4 Sampling at Depth with a Split Spoon (Barrel) Sampler

The procedure for split spoon sampling describes the collection and extraction of undisturbed soil cores of 18 or 24 inches in length. A series of consecutive cores may be extracted with a split spoon sampler to give a complete soil column profile, or an auger may be used to drill down to the desired depth for sampling. The split spoon is then driven to its sampling depth through the bottom of the augured hole and the core extracted.

When split spoon sampling is performed to gain geologic information, all work should be performed in accordance with ASTM D 1586-67 (reapproved 1974).

The following procedures will be used for collecting soil samples with a split spoon:

1. Assemble the sampler by aligning both sides of barrel and then screwing the drive shoe on the bottom and the head piece on top.
2. Place the sampler in a perpendicular position on the sample material.
3. Using a well ring, drive the tube. Do not drive past the bottom of the head piece or compression of the sample will result.
4. Record in the site logbook or on field data sheets the length of the tube used to penetrate the material being sampled, and the number of blows required to obtain this depth.
5. Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. The amount of recovery and soil type should be recorded on the boring log. If a split sample is desired, a cleaned, stainless steel knife should be used to divide the tube contents in half, longitudinally. This sampler is typically available in 2 and 3 ½ inch diameters. However, in order to obtain the required sample volume, use of a larger barrel may be required.
6. Without disturbing the core, transfer it to appropriate labeled sample container(s) and seal tightly.

#### 7.2.5 Sampling at Depth with a GeoProbe Sampler

The following procedures will be used for collecting soil samples with a GeoProbe:

1. The drilling contractor will assemble the sampler - which includes either a 24-inch or 48-inch long cellulose acetate butyrate (CAB) sampling sleeve.

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### *Soil Sampling - General*

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2. Place the sampler in a perpendicular position on the sample material.
3. Using the GeoProbe hydraulic system, drive the tube. Do not drive past the bottom of the head piece or compression of the sample will result.
4. Record in the site logbook or on field data sheets the length of the tube used to penetrate the material being sampled.
5. The GeoProbe contractor will withdraw the sampler. The CAB sleeve will be slit open to expose the soil sample, using a razor-blade type of utility knife. The amount of recovery and soil type should be recorded on the boring log. If a split sample is desired, a cleaned, stainless steel knife should be used to divide the tube contents in half, longitudinally.
6. Without disturbing the core, transfer it to appropriate labeled sample container(s) and seal tightly.
3. A shovel is used to remove a one to two inch layer of soil from the vertical face of the pit where sampling is to be done.
4. Samples are taken using a trowel, scoop, or coring device at the desired intervals. Be sure to *scrape the vertical face at the point of sampling* to remove any soil that may have fallen from above, and to expose fresh soil for sampling. In many instances, samples can be collected directly from the backhoe bucket.
5. If volatile organic analysis is to be performed using Encore™ samplers, refer to Section 7.2.3.1. If volatile organic analysis is to be performed using field preservation with Method 5035, refer to SOP # FW-C-011. If method 5035 is not to be used and volatile organic analysis is to be performed using Method 8260, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

#### 7.2.6 Test Pit/Trench Excavation

These relatively large excavations are used to remove sections of soil, when detailed examination of soil characteristics (horizontal, structure, color, etc.) are required. It is the least cost effective sampling method due to the relatively high cost of backhoe operation.

The following procedures will be used for collecting soil samples from test pit/trench excavations:

1. Prior to any excavation with a backhoe, it is important to ensure that all sampling locations are clear of utility lines, subsurface pipes and poles (subsurface as well as above surface).
2. Using the backhoe, a trench is dug to approximately three feet in width and approximately one foot below the cleared sampling location. Place excavated soils on plastic sheets. Trenches greater than five feet deep must be sloped or protected by a shoring system, as required by OSHA regulations.
6. Abandon the pit or excavation according to applicable state regulations. Generally, shallow excavations can simply be backfilled with the removed soil material.

#### **8.0 Calculations**

This section is not applicable to this SOP.

#### **9.0 Quality Assurance/Quality Control**

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## *Soil Sampling - General*

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There are no specific quality assurance (QA) activities which apply to the implementation of these procedures. However, the following QA procedures apply:

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1. All data must be documented on field data sheets or within site logbooks.
2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

### **10.0 Data Validation**

This section is not applicable to this SOP.

### **11.0 Health and Safety**

When working with potentially hazardous materials, follow U.S. EPA, OSHA and corporate health and safety procedures.

### **12.0 References**

U.S. EPA Environmental Response Team, SOP #2044 Rev. 0-0, October 3, 1994.

Mason, B.J., Preparation of Soil Sampling Protocol: Technique and Strategies. 1983 EPA-600/4-83-020.

Barth, D.S. and B.J. Mason, Soil Sampling Quality Assurance User's Guide. 1984 EPA-600/4-84-043.

U.S. EPA. Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods, Second Edition. 1984 EPA-600/4-84-076.

de Vera, ER, B.P. Simmons, R.D. Stephen, and D.L. Storm. Samplers and Sampling Procedures for Hazardous Waste Streams. 1980 EPA-600/2-80-018.

ASTM D 1586-67 (reapproved 1974), ASTM Committee on Standards, Philadelphia, PA.7

# CEI STANDARD OPERATING PROCEDURES

## *Sediment Sampling*

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SOP # FW-C-004

REVISION DATE: October 20, 1998

### 1.0 Scope and Application

This standard operating procedure (SOP) is applicable to the collection of representative sediment samples. Analysis of sediment may be biological, chemical, or physical in nature and may be used to determine the following:

- toxicity;
- biological availability and effects of contaminants; benthic biota;
- extent and magnitude of contamination;
- contaminant migration pathways and source;
- fate of contaminants;
- grain size distribution.

The methodologies discussed in this SOP are applicable to the sampling of sediment in both flowing and standing water. They are generic in nature and may be modified in whole or part to meet the handling and analytical requirements of the contaminants of concern, as well as the constraints presented by site conditions and equipment limitations. However, if modifications occur, they should be documented in a site or personal logbook and discussed in reports summarizing field activities and analytical results.

For the purposes of this procedure, sediments are those mineral and organic materials situated beneath an aqueous layer. The aqueous layer may be either static, as in lakes, ponds, and impoundments; or flowing, as in rivers and streams.

Mention of trade names or commercial products does not constitute U.S. EPA or Carlson Environmental, Inc. (CEI) endorsement or recommendation for use.

### 2.0 Method Summary

Sediment samples may be collected using a variety of methods and equipment, depending on the depth of the aqueous layer, the portion of the sediment profile required (surface vs. subsurface), the type of

sample required (disturbed vs. undisturbed), contaminants present, and sediment type.

Sediment is collected from beneath an aqueous layer either directly, using a hand held device such as a shovel, trowel, or auger; or indirectly, using a remotely activated device such as an Ekman or Ponar dredge. Following collection, sediment is transferred from the sampling device to a sample container of appropriate size and construction for the analyses requested. If composite sampling techniques are employed, multiple grabs are placed into a container constructed of inert material, homogenized, and transferred to sample containers appropriate for the analyses requested. The homogenization procedure should not be used if sample analysis includes volatile organics; in this case, sediment, or multiple grabs of sediment, should be transferred directly from the sample collection device or homogenization container to the sample container.

### 3.0 Sample Preservation, Containers, Handling and Storage

*If the sample is to be analyzed for volatile organic compounds (VOCs), field preservation methods in accordance with EPA Method 5035 may be appropriate (refer to SOP FW-C-011).*

1. Chemical preservation of solids is generally not recommended. Cooling to 4° C is usually the best approach, supplemented by the appropriate holding time for the analyses requested.
2. Wide mouth glass containers with Teflon lined caps are utilized for sediment samples. The sample volume is a function of the analytical requirements and will be specified in the Work Plan.
3. If analysis of sediment from a discrete depth or location is desired, sediment is transferred directly from the sampling device to a labeled sample container(s) of appropriate size and construction for the analyses requested. Transfer is accomplished stainless steel or plastic lab spoon or equivalent.

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## *Sediment Sampling*

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4. If composite sampling techniques or multiple grabs are employed, equal portions of sediment from each location are deposited into a stainless steel, plastic, or other appropriate composition (e.g., Teflon) containers. The sediment is homogenized thoroughly to obtain a composite representative of the area sampled. The composite sediment sample is transferred to a labeled container(s) of appropriate size and construction for the analyses requested. Transfer of sediment is accomplished with a stainless steel or plastic lab spoon or equivalent. Samples for volatile organic analysis must be transferred directly from the sample collection device or pooled from multiple areas in the homogenization container prior to mixing. This is done to minimize loss of contaminant due to volatilization during homogenization.
5. All sampling devices should be decontaminated, then wrapped in aluminum foil. The sampling device should remain in this wrapping until it is needed. Each sampling device should be used for only one sample. Disposable sampling devices for sediment are generally impractical due to cost and the large number of sediment samples which may be required. Sampling devices should be cleaned in the field using the decontamination procedure described in the Sampling Equipment Decontamination SOP # FW-S-007.

### **4.0 Interferences and Potential Problems**

Substrate particle size and organic matter content are a direct consequence of the flow characteristics of a water body. Contaminants are more likely to be concentrated in sediments typified by fine particle size and a high organic matter content. This type of the sediment is most likely to be collected from depositional zones. In contrast, coarse sediments with low organic matter content do not typically concentrate pollutants and are generally found in erosional zones. The selection of a sampling location can, therefore, greatly influence the analytical results and should be justified and specified in the Work Plan.

### **5.0 Equipment/Apparatus**

Equipment needed for collection of sediment samples may include:

- Maps/plot plan
- Safety equipment
- Compass
- Tape measure
- Survey stakes, flags, or buoys and anchors
- Camera and film
- Stainless steel, plastic, or other appropriate composition bucket
- 4-oz., 8-oz., and one-quart wide mouth jars w/Teflon lined lids
- Ziploc plastic bags
- Logbook
- Sample jar labels
- Chain of Custody records, field data sheets
- Cooler(s)
- Ice
- Decontamination supplies/equipment
- Spade or shovel
- Spatula
- Scoop
- Trowel
- Bucket auger
- Tube auger
- Extension rods
- "T" handle
- Sediment coring device (tube, drive head, eggshell check valve, nosecone, acetate tube, extension rods, "T" handle)
- Ponar dredge
- Ekman dredge
- Nylon rope or steel cable
- Messenger device

### **6.0 Reagents**

Reagents are not used for preservation of sediment samples. Decontamination solutions are specified in the Sampling Equipment Decontamination SOP # FW-S-007.



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## 7.0 PROCEDURES

### 7.1 Preparation

1. Determine the objective(s) and extent of the sampling effort. The sampling methods to be employed, and the types and amounts of equipment and supplies required will be a function of site characteristics and objectives of the study.
2. Obtain the necessary sampling and monitoring equipment.
3. Prepare schedules, and coordinate with staff, client, and regulatory agencies, if appropriate.
4. Decontaminate or preclean equipment, and ensure that it is in working order.
5. Perform a general site survey prior to site entry in accordance with the site specific Health and Safety Plan.
6. Use stakes, flagging, or buoys to identify and mark all sampling locations. Specific site factors including flow regime, basin morphometry, sediment characteristics, depth of overlying aqueous layer, contaminant source, and extent and nature of contamination should be considered when selecting sample locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

### 7.2 Sample Collection

Selection of a sampling device is most often contingent upon: (1) the depth of water at the sampling location, and (2) the physical characteristics sediment to be sampled. If VOCs analysis is to be performed, once the sample has been retrieved using one of the methods listed below, the sample should be preserved in accordance with EPA Method 5035 (refer to SOP FW-C-011). The following procedures may be utilized:

#### 7.2.1 Sampling Surface Sediment with a Trowel or Scoop from Beneath a Shallow Aqueous Layer

For the purpose of this method, surface sediment is considered to range from 0 to six inches in depth and a shallow aqueous layer is considered to range from 0 to 12 inches in depth. Collection of surface sediment from beneath a shallow aqueous layer can be accomplished with tools such as spades, shovels, trowels, and scoops. Although this method can be used to collect both unconsolidated/consolidated sediment, it is limited somewhat by the depth and movement of the aqueous layer. Deep and rapidly flowing water render this method less accurate than others discussed below. However, representative samples can be collected with this procedure in shallow sluggish water provided care is demonstrated by the sample team member. A stainless steel or plastic sampling implement will suffice in most applications. Care should be exercised to avoid the use of devices plated with chrome or other materials; plating is particularly common with garden trowels.

The following procedure will be used to collect sediment with a scoop, shovel, or trowel:

1. Using a decontaminated sampling implement, remove the desired thickness and volume of sediment from the sampling area.
2. Transfer the sample into an appropriate sample or homogenization container. Ensure that non-dedicated containers have been adequately decontaminated.
3. Surface water should be decanted from the sample or homogenization container prior to sealing or transfer; care should be taken to retain the fine sediment fraction during this procedure.

#### 7.2.2 Sampling Surface Sediment with a Bucket Auger or Tube Auger from Beneath a Shallow Aqueous Layer

For the purpose of this method, surface sediment is considered to range from 0 to six inches in depth and a shallow aqueous layer is considered to range

## CEI STANDARD OPERATING PROCEDURES

### *Sediment Sampling*

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from 0 to 24 inches in depth. Collection of surface sediment from beneath a shallow aqueous layer can be accomplished with a system consisting of bucket auger or tube auger, a series of extensions, and a "T" handle. The use of additional extensions in conjunction with a bucket auger can increase the depth of water from which sediment can be collected from 24 inches to 10 feet or more. However, sample handling and manipulation increases in difficulty with increasing depth of water. The bucket auger or tube auger is driven into the sediment and used to extract a core. The various depths represented by the core are homogenized or a subsample of the core is taken from the appropriate depth.

The following procedure will be used to collect sediment samples with a bucket auger or tube auger:

1. An acetate core may be inserted into the bucket auger or tube auger prior to sampling if characteristics of the sediments or water body warrant. By using this technique, an intact core can be extracted.
2. Attach the auger head to the required length of extensions, then attach the "T" handle to the upper extension.
3. Clear the area to be sampled of any surface debris.
4. Insert the bucket auger or tube auger into the sediment at a 0° to 20° angle from vertical. This orientation minimizes spillage of the sample from the sampler upon extraction from the sediment and water.
5. Rotate the auger to cut a core of sediment.
6. Slowly withdraw the auger; if using a tube auger, make sure that the slot is facing upward.
7. Transfer the sample or a specified aliquot of sample into an appropriate sample or homogenization container. Ensure that non-dedicated containers have been adequately decontaminated.

#### 7.2.3 Sampling Deep Sediment with a Bucket Auger or Tube Auger from Beneath a Shallow Aqueous Layer

For the purpose of this method, deep sediment is considered to range from six to greater than 18 inches in depth and a shallow aqueous layer is considered to range from 0 to 24 inches. Collection of deep sediment from beneath a shallow aqueous layer can be accomplished with a system consisting of a bucket auger, a tube auger, a series of extensions and a "T" handle. The use of additional extensions can increase the depth of water from which sediment can be collected from 24 inches to five feet or more. However, water clarity must be high enough to permit the sampler to directly observe the sampling operation. In addition, sample handling and manipulation increases in difficulty with increasing depth of water. The bucket auger is used to bore a hole to the upper range of the desired sampling depth and then withdrawn. The tube auger is then lowered down the borehole, and driven into the sediment to the lower range of the desired sampling depth. The tube is then withdrawn and the sample recovered from the tube. This method can be used to collect firmly consolidated sediments, But is somewhat limited by the depth of the aqueous layer, and the integrity of the initial borehole.

The following procedure will be used to collect deep sediment samples with a bucket auger and a tube auger:

1. Attach the bucket auger bit to the required lengths of extensions, then attach the "T" handle to the upper extension.
2. Clear the area to be sampled of any surface debris.
3. Begin auguring, periodically removing any accumulated sediment (i.e., cuttings) from the auger bucket. Cuttings should be disposed of far enough from the sampling area to minimize cross contamination of various depths.

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### *Sediment Sampling*

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4. After reaching the upper range of the desired depth, slowly and carefully remove bucket auger from the boring.
5. Attach the tube auger bit to the required lengths of extensions, then attach the "T" handle to the upper extension.
6. Carefully lower tube auger down borehole using care to avoid making contact with the borehole sides and, thus, cross contaminating the sample. Gradually force tube auger into sediment to the lower range of the desired sampling depth. Hammering of the tube auger to facilitate coring should be avoided as the vibrations may cause the boring walls to collapse.
7. Remove tube auger from the borehole, again taking care to avoid making contact with the borehole sides and, thus, cross contaminating the sample.
8. Discard the top of core (approximately 1 inch); as this represents material collected by the tube auger before penetration to the layer concern.
9. Transfer sample into an appropriate sample or homogenization container. Ensure that non-dedicated containers have been adequately decontaminated.

#### 7.2.4 Sampling Surface Sediment with an Ekman or Ponar Dredge from Beneath a Shallow or Deep Aqueous Layer

For the purpose of this method, surface sediment is considered to range from 0 to six inches in depth. Collection of surface sediment can be accomplished with a system consisting of a remotely activated device (dredge) and a deployment system. This technique consists of lowering a sampling device (dredge) to the surface of the sediment by use of a rope, cable, or extended handle. The mechanism is activated, and the device entraps sediment in spring loaded or lever operated jaws.

An Ekman dredge is a lightweight sediment sampling device with spring activated jaws. It is

used to collect moderately consolidated, fine textured sediment. The following procedure will be used for collecting sediment with an Ekman dredge

1. Attach a sturdy nylon rope or stainless steel cable through the hole on the top of the bracket, or secure the extension handle to the bracket with machine bolts.
2. Attach springs to both sides of the jaws. Fix the jaws so that they are in open position by placing trip cables over the release studs. Ensure that the hinged doors on the dredge top are free to open.
3. Lower the sampler to a point 4 to 6 inches above the sediment surface.
4. Drop the sampler to the sediment.
5. Trigger the jaw release mechanism by lowering a messenger down the line, or by depressing the button on the upper end of the extension handle.
6. Raise the sampler and slowly decant any free liquid through the top of the sampler. Care should be taken to retain the fine sediment fraction during this procedure.
7. Open the dredge jaws and transfer the sample into a stainless steel, plastic or other appropriate composition (e.g., Teflon) container. Ensure that non-dedicated containers have been adequately decontaminated. If necessary, continue to collect additional sediment grabs until sufficient material has been secured to fulfill analytical requirements. Thoroughly homogenize and then transfer sediment to sample containers appropriate for the analyses requested. Samples for volatile organic analysis must be collected directly from the bucket before homogenization to minimize volatilization of contaminants.

A Ponar dredge is a heavyweight sediment sampling device with weighted jaws that are lever or spring activated. It is used to collect consolidated fine to coarse textured sediment. The following procedure will be used for collecting sediment with a Ponar dredge

# CEI STANDARD OPERATING PROCEDURES

## *Sediment Sampling*

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1. Attach a sturdy nylon rope or steel cable to the ring provided on top of the dredge.
2. Arrange the Ponar dredge with the jaws in the open position, setting the trip bar so the sampler remains open when lifted from the top. If the dredge is so equipped, place the spring loaded pin into the aligned holes in the trip bar.
3. Slowly lower the sampler to a point approximately two inches above the sediment.
4. Drop the sampler to the sediment. Slack on the line will release the trip bar or spring loaded pin; pull up sharply on the line
5. Raise the dredge to the surface and slowly decant any free liquid through the screens on top of the dredge. Care should be taken to retain the fine sediment fraction during this operation.
6. Open the dredge and transfer the sediment to a stainless steel, plastic or other appropriate composition (e.g., Teflon) container. Ensure that non-dedicated containers have been adequately decontaminated. If necessary, continue to collect additional sediment until sufficient material has been secured to fulfill requirements. Thoroughly homogenized and then transfer sediment for the analyses requested. Samples for volatile organic analysis must be collected directly from the bucket before homogenization to minimize volatilization of contaminants.

### 7.2.5 Sampling Subsurface Sediment with a Coring Device from Beneath a Shallow Aqueous Layer

For purposes of this method, subsurface sediment is considered to range from 6 to 24 inches in depth and a shallow aqueous layer is considered to range from 0 to 24 inches in depth. Collection of subsurface sediment from beneath a shallow aqueous layer can be accomplished with a system consisting of a tube sampler, acetate tube, eggshell check valve, nosecone, extensions, and "T" handle, or drivehead. The use of additional extensions can increase the depth of water from which sediment can be

collected from 24 inches to 10 feet or more. This sampler may be used with either a drive hammer for firm sediment, or a "T" handle for soft sediment. However, sample handling and manipulation increases in difficulty with increasing depth of water.

The following procedure describes the use of a sample coring device used to collect subsurface sediments.

1. Assemble the coring device by inserting the acetate core into the sampling tube.
2. Insert the "egg shell" check valve into the lower end of the sampling tube with the convex surface positioned inside the acetate core.
3. Screw the nosecone onto the lower end of the sampling tube, securing the acetate tube and eggshell check valve.
4. Screw the handle onto the upper end of the sampling tube and add extension rods as needed.
5. Place the sampler in a perpendicular position on the sediment to be sampled.
6. If the "T" handle is used, place downward pressure on the device until the desired depth is reached. After the desired depth is reached, rotate the sampler to shear off the core at the bottom. Slowly withdraw the sampler from the sediment and proceed to step 15.
7. If the drive hammer is selected, insert the tapered handle (drive head) of the drive hammer through the drive head.
8. Drive the sampler into the sediment to the desired depth.
9. Record the length of the tube that penetrated the sample material, and the number of blows required to obtain this depth.
10. Remove the drive hammer and fit the keyhole-like opening on the flat side of the hammer onto

# CEI STANDARD OPERATING PROCEDURES

## *Sediment Sampling*

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the drive head. In this position, the hammer serves as a handle for the sampler.

11. Rotate the sampler to shear off the core at the bottom.
12. Lower the sampler handle (hammer) until it just clears the two ear-like protrusions on the drive head, and rotate about 90°.
13. Slowly withdraw the sampler from the sediment. *If the drivehead was used, pull the hammer upwards and dislodge the sampler from the sediment.*
14. Carefully remove the coring device from the water.
15. Unscrew the nosecone and remove eggshell check valve.
16. Slide the acetate core out of the sampler tube. Decant surface water, using care to retain the fine sediment fraction. If head space is present in the upper end, a hacksaw may be used to shear the acetate tube off at the sediment surface. The acetate core may then be capped at both ends. *Indicate on the acetate tube the appropriate orientation of the sediment core using a waterproof marker. The sample may be used in this fashion, or the contents transferred to a sample or homogenization container.*
17. Open the acetate tube and transfer the sediment to a stainless steel, plastic or other appropriate composition (e.g., Teflon) container. Ensure that non-dedicated containers have been adequately decontaminated. If necessary, continue to collect additional sediment until sufficient material has been secured to fulfill analytical requirements. Thoroughly homogenize and then transfer sediment to sample containers appropriate for the analyses requested. Samples for volatile organic analysis must be collected directly from the bucket before homogenization to minimize volatilization of contaminants.

### 8.0 Calculations

This section is not applicable to this SOP.

### 9.0 Quality Assurance/Quality Control

There are no specific quality assurance (QA) activities which apply to the implementation of these procedures. However, the following QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks.
2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

### 10.0 Data Validation

This section is not applicable to this SOP.

### 11.0 Health and Safety

When working with potentially hazardous materials, follow U.S. EPA/OSHA and Corporate health and safety procedures.

More specifically, when sampling sediment from water bodies, physical hazards must be identified and adequate precautions must be taken to ensure the safety of the sampling team. The team member collecting the sample should not get too close to the edge of the water body, where bank failure may cause loss of balance. To prevent this, the person performing the sampling should be on a lifeline, and be wearing adequate protective equipment. If sampling from a vessel is determined to be necessary, appropriate protective measures must be implemented.

## CEI STANDARD OPERATING PROCEDURES

### *Sediment Sampling*

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**12.0 References** -USEPA Environmental Response Team, SOP #2016 Rev. 0-0, October 3,1994.

Mason, B.J., Preparation of Soil Sampling Protocol: Technique and Strategies. 1983 EPA-600/4-83-020.

Barth, D.S. and B.J. Mason, Soil Sampling Quality Assurance User's Guide. 1984 EPA-600/4-84-043.

U.S. EPA. Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods, Second Edition. 1984 EPA-600/4-84-076.

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# CEI STANDARD OPERATING PROCEDURES

## *Field Sample Collection for Method 5035*      *Page 1*

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SOP # FW-C-011

DATE: JUNE 3, 1999

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### 1.0 Scope and Application

The purpose of this standard operating procedure (SOP) is to provide guidance in proper field techniques for U.S. EPA Method 5035 sample preservation. U.S. EPA Method 5035 is a closed-system purge-and-trap process for analysis of volatile organic compounds (VOCs) in solid materials (e.g., soils, sediments and solid waste). This method requires soil samples to be preserved in one of two preservatives prior to analysis, either in the field at the time of collection, or in the laboratory within 48 hours of collection.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (U.S. EPA) or Carlson Environmental, Inc. (CEI) endorsement or recommendation for use.

### 2.0 Method Summary

The Method 5035 sampling procedure specifies that the sample needs to be preserved either at the time of sample collection (field preservation) or by the laboratory. If the laboratory is to preserve the samples, EnCore™ samplers will be used to encapsulate the sample at the time of collection.

Regardless of whether field or laboratory preservation is to be used, a separate (unpreserved) dry weight sample should be collected.

#### Field Preservation

A sodium bisulfate preservative is used for soils containing less than 200 ppb, and methanol preservative is used in soils containing greater than 200 ppb.

#### Laboratory Preservation

If the soil samples are to be preserved in the laboratory, the samples must be collected in a Purge-and-Trap Soil Sampler™ (Model 3780PT) or equivalent, or in an EnCore™ sampler or equivalent, and must then be delivered to the lab for preservation within 48 hours of sample collection.

### 3.0 Sample Preservation, Containers, Handling and Storage

However, all samples should be cooled to 4° C and protected from sunlight in order to minimize any potential reaction due to the light sensitivity of the sample.

#### Field Preservation

For the field preservation methods, the amount of soil placed in the preservative should be performed to maintain a 1:1 ratio between the soil and preservative (i.e., 5 g of soil into 5 mL of sodium bisulfate). To maintain the desired 1:1 ratio, the sample will be weighed in the field at the time of collection and placed into pre-weighed sample containers. The laboratory will re-weigh the jars to determine the precise amount of sample placed in the container.

Each laboratory has its own SOP for Method 5035, therefore each laboratory provides its own pre-weighed sample vials to CEI that contain a predetermined amount of preservative. The following guidance is provided for laboratories commonly used by CEI. The laboratories generally request that two vials be submitted for the low level analysis and one sample container for the medium level analysis.

An unpreserved soil sample for dry weight analysis should be placed in a 4 oz. jar.

#### *Sima Labs International:*

Sima pre-weighed sample vials should contain 5 mL of sodium bisulfate for preservative in low concentration soil samples and 10 mL of methanol for preservative in high concentration soil samples. Each vial should also contain a small stir bar.

#### *Great Lakes Analytical (GLA)*

GLA pre-weighed sample vials should contain 5 mL of distilled water to which 5g of sodium bisulfate for

# CEI STANDARD OPERATING PROCEDURES

## *Field Sample Collection for Method 5035* Page 2

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SOP # FW-C-011

DATE: JUNE 3, 1999

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preservative in low concentration soil samples has been added, along with a stir bar.

For the medium concentration samples, approximately 25 g of soil should be placed into a 2 or 4-ounce sample jar, to which 10 mL of methanol (supplied by GLA in a vial) is added for preservative in medium level soil samples.

### EnCore™ Samplers

The EnCore™ Samplers are supplied in individually sealed foil bags. Two different sampler sizes (5 g and 25g) are available which correspond to the low level and medium level analyses. A new sampler is used for each sample. The sampler is attached to a trier (T-shaped handle). The sampler is inserted into the soil to be sampled until the indicator is visible in the view finder. At this point, an adequate volume of soil is present and the sampler can be detached from the trier. The sampler automatically locks, encapsulating the sample, until it is extracted and preserved at the laboratory. The sample container should be returned to its original foil bag, which can be resealed and labeled with the sample number.

### **4.0 Interferences and Potential Problems**

As with any sampling procedure for volatiles, care must be taken to minimize the disturbance of the sample in order to minimize the loss of the volatile components. The samples should be collected as soon as possible after the surface of the soil is exposed to the atmosphere (within a few minutes). Also, sample vials should be kept closed at all times not to allow volatiles to escape, before and after sample collection.

### **5.0 Equipment/Apparatus**

Method 5035 requires all equipment listed in FW-S-001 and the following:

- Ziploc plastic bags
- Logbook
- Sample jar labels

- Chain of Custody records, field data sheets
- Cooler(s)
- Ice
- Decontamination supplies/equipment
- 4 oz jars for dry weight samples

### for Field Preservation Method

- Field balance, with calibration weights
- Appropriate 40 mL vials with preservative & 4 oz. jars

### for Laboratory Preservation Method

- EnCore™ samplers or equivalent
- "T" handle sampler

### **6.0 Reagents**

#### for Field Preservation Method

- Organic-free reagent water
- Methanol, CH<sub>3</sub>OH
- Sodium bisulfate, NaHSO<sub>4</sub>

#### for Laboratory Preservation Method

no reagents are required

### **7.0 Procedures**

As with any sampling procedure for volatiles, care must be taken to minimize the disturbance of the sample in order to minimize the loss of the volatile components. Also, sample vials should be kept closed at all times not to allow volatiles to escape, before and after sample collection.

#### 7.1 Low Concentration soil samples

7.1.1 Using an appropriate sample collection device, collect approximately 5 grams of sample. The samples should be collected as soon as possible after the surface of the soil is exposed to the atmosphere (within a few minutes).



# CEI STANDARD OPERATING PROCEDURES

## *Field Sample Collection for Method 5035* Page 3

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SOP # FW-C-011

DATE: JUNE 3, 1999

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7.1.2 Using the sample collection device, transfer approximately 5 grams of the soil sample to a sample vial with sodium bisulfate preservative. Quickly clean the vial threads and immediately reseal the vial with the septum and screw-cap. Store on ice at 4° C.

Note: Soil samples that contain carbonate minerals may effervesce upon contact with the acidic preservative solution in the low concentration sample vial. If large amounts of gas are generated quickly, the sample may lose a significant amount of analyte and the pressure may shatter the vial if it is sealed. Therefore, a test sample should be collected and tested for effervescence. If the sample reacts rapidly or vigorously, discard it and collect a sample without preservative or use EnCore™ sampler.

7.1.3 If the EnCore™ sampler or equivalent is used, the sample should be transferred to the sample vial as soon as possible or analyzed within 48 hours.

7.1.4 Label and number the vial. Record the collection data in the field log book.

### 7.2 High Concentration soil samples

7.2.1 Using an appropriate sample collection device, collect approximately 5 grams of sample. The samples should be collected as soon as possible after the surface of the soil is exposed to the atmosphere (within a few minutes).

7.2.2 Using the sample collection device, transfer approximately 5 grams of the soil sample to a sample vial with methanol preservative. Quickly clean the vial threads and immediately reseal the vial with the septum and screw-cap. Store on ice at 4° C.

### 7.3 High Concentration soil sample not preserved in the field

7.3.1 When sample preservation is not used, it is better to place the sample in a 4 oz. jar. Fill the jar as full as practical in order to minimize headspace.

7.3.2 Label and number the jar. Record the collection data in the field log book.

### 7.4 Oily waste samples

7.4.1 If the oily waste is soluble in methanol or polyethylene glycol, then the sample may be collected as in section 7.2.

7.4.2 If the oily waste is not soluble in methanol or polyethylene glycol (PEG), then the sample may be collected without preservative, as in section 7.3.

Note: A field test may be performed to determine if the oily waste is soluble, by placing a test sample in the solvent.

7.4.3 Label and number the vial. Record the collection data in the field log book.

### 7.5 Dry weight analysis

7.5.1 An additional sample shall be taken for dry weight analysis. The sample should be placed in a 4 oz. jar. The jar should be filled as much as practical to minimize the headspace.

7.5.2 Label and number the jar. Record the collection data in the field log book.

## **8.0 Calculations**

*Not applicable.*

## **9.0 Quality Assurance/Quality Control**

There are no specific quality assurance (QA) activities which apply to the implementation of these procedures. However, the following QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks.
2. All instrumentation must be operated in accordance with operating instructions as

## CEI STANDARD OPERATING PROCEDURES

### *Field Sample Collection for Method 5035*      *Page 4*

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supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

#### **10.0 Data Validation**

*Not applicable.*

#### **11.0 Health and Safety**

When working with potentially hazardous materials, follow U.S. EPA/OSHA and Corporate health and safety procedures.

More specifically, physical hazards must be identified and adequate precautions must be taken to ensure the safety of the sampling team. Proper personal protective equipment should be tested and worn to minimize risk.

#### **12.0 References**

U.S. EPA SW-846 Method 5035

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# CEI STANDARD OPERATING PROCEDURES

## *QED FC4000 - Use and Calibration*

Page 1

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SOP # FW-E-003

REVISION DATE: June 1, 1999

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### **1.0 Scope and Application**

The purpose of this Standard Operating Procedure (SOP) is to set guidelines for using the QED FC4000 instrument to measure pH, temperature and conductivity of the ground water during the monitoring well development, purging and sampling activities. The consistency and stability of these parameters is important in demonstrating that the collected sample appears to be representative of aquifer conditions.

The FC4000 is a multiparameter, water quality measurement and data collection system. The meter is equipped with powerful software making it ideal for water sampling. The sonde simultaneously houses temperature, conductivity, dissolved oxygen, Oxidation Reduction Potential (ORP) and pH sensors (the use of the dissolved oxygen and ORP sensor are not presented in this SOP). The sonde can be used 200 feet below the water's surface or in as little as a few inches of water, and will fit down a 2-inch diameter monitoring well.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

### **2.0 Method Summary**

Within one week after each well has been constructed, but no sooner than 48 hours after grouting is completed, the wells should be developed in conjunction with SOP CEI-S-006. The purpose of this development is to stabilize and increase permeability of the gravel pack around the well screen and to restore the permeability which may have been reduced by drilling operations. The QED FC4000 can be used during the development, purging and sampling activities to

### **3.0 Sample Preservation, Containers, Handling and Storage**

This section is not applicable to this standard operating procedure (SOP).

### **4.0 Interferences and Potential Problems**

Proper calibration should be conducted prior to use.

The unit is battery powered and the Nickel Metal Hydride battery should be fully charged the day before use. The battery should last for 6-8 hours and the meter will beep persistently when approximately 1 hour of battery life remains.

The sensors can be replaced in the field, however do not disassemble the probe to avoid damaging the internal wiring.

### **5.0 Equipment/Apparatus**

Field equipment includes:

- QED FC4000 meter
- external flow cell pump
- Tools (screwdriver, wrench)
- Logbook
- Paper towels
- Groundwater monitoring forms

### **6.0 Reagents**

No chemical reagents are used during the unit operation. After use, decontamination is necessary, refer to the SOP for Sampling Equipment Decontamination, and the site specific work plan.

Calibration for conductivity is performed using 300 mL of one of the following standards:

- A 1 mS/cm conductivity standard for fresh water measurements
- A 10 mS/cm conductivity standard for brackish water measurements
- A 50 mS/cm conductivity standard for sea water measurements

Calibration for pH is performed using 200 mL of pH7 buffer.

# CEI STANDARD OPERATING PROCEDURES

## *QED FC4000 - Use and Calibration*

Page 2

### 7.0 Procedures

#### 7.1 Calibration

A calibration cup is supplied with the FC4000. From the sonde Main menu, select 2. *Calibrate*. The calibrate menu will be displayed. Select the number which corresponds to the parameter for which you are calibrating the instrument. The sintered metallic oxide thermistor for temperature measurement does not require calibration.

##### 7.1.1 Calibration for Conductivity

- Place approximately 300 mL of conductivity standard in a clean and dry calibration cup. The conductivity standard selected should be within the same conductivity range as the water being sampled (refer to Section 6.0 above).

*Caution - Before proceeding, insure that the sensor is as dry as possible. Ideally, rinse the conductivity sensor with a small amount of standard that can be discarded.*

- Without removing the sonde guard, carefully immerse the probe end of the sonde into the solution. Gently rotate and/or move the sonde up and down to remove any bubbles from the conductivity cell. The probe must be completely immersed past its vent hole.
- Allow at least one minute for temperature equilibration before proceeding.
- From the Calibrate menu, select 1. *Conductivity* to access the Conductivity calibration procedure and then 1. *SpCond*. to access the specific conductance calibration procedure. Enter the calibration value of the standard you are using and press Enter. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

- Observe the readings under Specific Conductance or Conductivity and when they show no significant change for approximately 30 seconds, press Enter. The screen will indicate that the calibration has been accepted and prompt you to press Enter again and return to the Calibrate menu.
- Rinse the sonde in tap or purified water and dry the sonde.

##### 7.1.2 Calibration for pH

- Place approximately 200 mL of pH7 buffer in a clean calibration cup. Carefully immerse the probe end of the sonde into the solution.
- Allow at least 1 minute for temperature equilibration before proceeding.
- From the Calibrate menu, select 4. *ISE1 pH* to access the pH calibration choices and then press 2. *2-Point*. Press Enter and input the value of the buffer (7) at the prompt. Press Enter and the current values of all enabled sensors will appear on the screen and will change with time as they stabilize in the solution. Observe the readings under pH and when they show no significant change for approximately 30 seconds, press Enter. The display will indicate that the calibration is accepted.
- After the pH 7 calibration is complete, press Enter again, as instructed on the screen, to continue.
- Rinse the sonde in water and dry the sonde before proceeding to the next step.
- Place approximately 200 mL of a second pH buffer solution in a clean calibration cup. The second buffer might be pH 4 if the sample is expected to be acidic or pH 10 if the sample is expected to be basic.

# CEI STANDARD OPERATING PROCEDURES

## *QED FC4000 - Use and Calibration*

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Carefully immerse the probe end of the sonde into the solution.

- Allow at least 1 minute for temperature equilibration before proceeding.
- Press Enter and input the value of the second buffer at the prompt. Press Enter and the current values of all enabled sensors will appear on the screen and will change with time as they stabilize in the solution. Observe the readings under pH and when they show no significant change for approximately 30 seconds, press Enter. After second value calibration is complete, press Enter again, as instructed on the screen, to return to the Calibration menu.
- Rinse the sonde in water and dry. Thoroughly rinse and dry the calibration cups for future use.

### 7.2 Procedures

The system connections and configurations are included in the attached Figures 1 through 6. Prior to use, the battery should be charged and the sensors calibrated. The connectors and supplies referenced below are included in the storage case for the FC4000.

#### Connecting the Sonde

The meter is connected to the sonde using two cables: a short DB-9 pigtail assembly, and a long sonde profiling cable. The pigtail mates to the meter by sliding its proprietary connector into the right slot of the meter (viewed from the rear) and snapping it into place. It can be removed by depressing its plastic tab and sliding it out again.

The pigtail mates to the sonde Profiling cable directly through its DB-9 connector.

*Note - The small round 3-pin connector at the end of the Profiling cable is NOT connected to the meter. It*

*is only used for SDI-12 interface to the sonde, or for externally providing power to the sonde.*

#### Power Up

The meter is turned on by pressing the Power key, or by plugging in the external battery charger. It is turned off by pressing the Power key, pressing the Power key twice with charger connected, or by a battery-saving automatic shut-off feature.

#### Software Installation and Site Setup

Section 2.5 of the user's manual describes how to install software to upload the meter readings into a desktop computer. Prior to performing the site work, files and headers for the pending site work can be established using computer keyboard rather than performing these setup activities in the field. Please refer to Section 2.5 of the user's manual if you are unfamiliar with these steps.

#### Entering Data

The meter is menu-driven. Use the arrow keys to navigate the menu tree. After highlighting your selection (by using the arrow keys), press Enter. Press the Esc key to move backwards.

If you wish to overwrite an entry, select/highlight the entry and press Enter. Inputs can always be entered in upper or lower case.

Durations and Intervals, which appear on logging and deployment menus, are entered in a special way. Values may be entered in units of seconds (s), minutes (m), hours (h) or days (d). You must type a number followed by a letter to designate the units. For example, for 15 seconds, enter "15s".

#### Logging on the Meter

There are four main areas under the Logging menu, as listed below. The logging procedures produces a file in the standard file format, capable of being uploaded to a PC and processed by the software.

# CEI STANDARD OPERATING PROCEDURES

## *QED FC4000 - Use and Calibration*

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- (1) The Setup Header menu allows you to specify control and timing for the deployment.
- (2) The Setup Filter menu allows you to automatically discard samples that do not meet your criteria
- (3) The Start Meter Logging item begins the logging session as specified in the Setup Header and Setup Filter menus.
- (4) The Logging Information screen tells you how much space is available for additional logging, and how much time that corresponds to in Capture mode.

### Run Mode

Run mode is accessed by selecting Run from the Main menu, or by powering up the meter with the sonde connected. In Run mode, the meter constantly requests live data from the sonde and displays it on the screen. A bullet on the top line of the screen toggles each time the screen is updated with new data. The sonde sends data every half second. The screen shows up to 12 parameters and data. Additional parameters are accepted but cannot be shown.

### Uploading

Please refer to the user manual if you are not familiar with the office procedures for uploading the field data.

### **8.0 Calculations**

The algorithms for conversion of resistance to temperature is built into the software. The software calculates pH from the established linear relationship between pH and the millivolt output as defined by a variation of the Nernst equation.

No calculations by the user are required.

### **9.0 Quality Assurance/Quality Control**

The following general quality assurance procedures apply:

1. All data must be documented on standard chain of custody forms, field data sheets, groundwater level data forms, or within personal/site logbooks.
2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

### **10.0 Data Validation**

Permitting the system to equilibrate and collecting multiple readings is the preferred method of validating the data, at the time of collection.

The sensors' performance specifications are listed below:

#### Temperature

Sensor Type ..... Thermistor  
Range ..... -5 to 45 °C  
Accuracy ..... +/- 0.15°C  
Resolution ..... 0.01°C

#### Conductivity

Sensor Type ..... 4 electrode cell  
Range ..... 0 to 100 mS/cm  
Accuracy ..... +/- 0.5% of reading + 0.001 mS/cm  
Resolution ..... 0.01 mS/cm or 1 uS/cm

#### pH

Sensor Type ..... Glass combination electrode  
Range ..... 2 to 14 units  
Accuracy ..... +/- 0.2 units  
Resolution ..... 0.01 units

## CEI STANDARD OPERATING PROCEDURES

### *QED FC4000 - Use and Calibration*

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#### **11.0 Health and Safety**

When working with potentially hazardous materials, follow U.S. EPA, OSHA, or corporate health and safety practices.

#### **12.0 References**

QED Environmental Systems, Inc., *Model FC4000 Water Analyzer User's Guide*, Rev.#1, 1996.

Driscoll, F.G., 1986, Groundwater and wells: Johnson Division, St. Paul, Minnesota, 1108 p.

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# FC4000 Water Analyzer SONDE

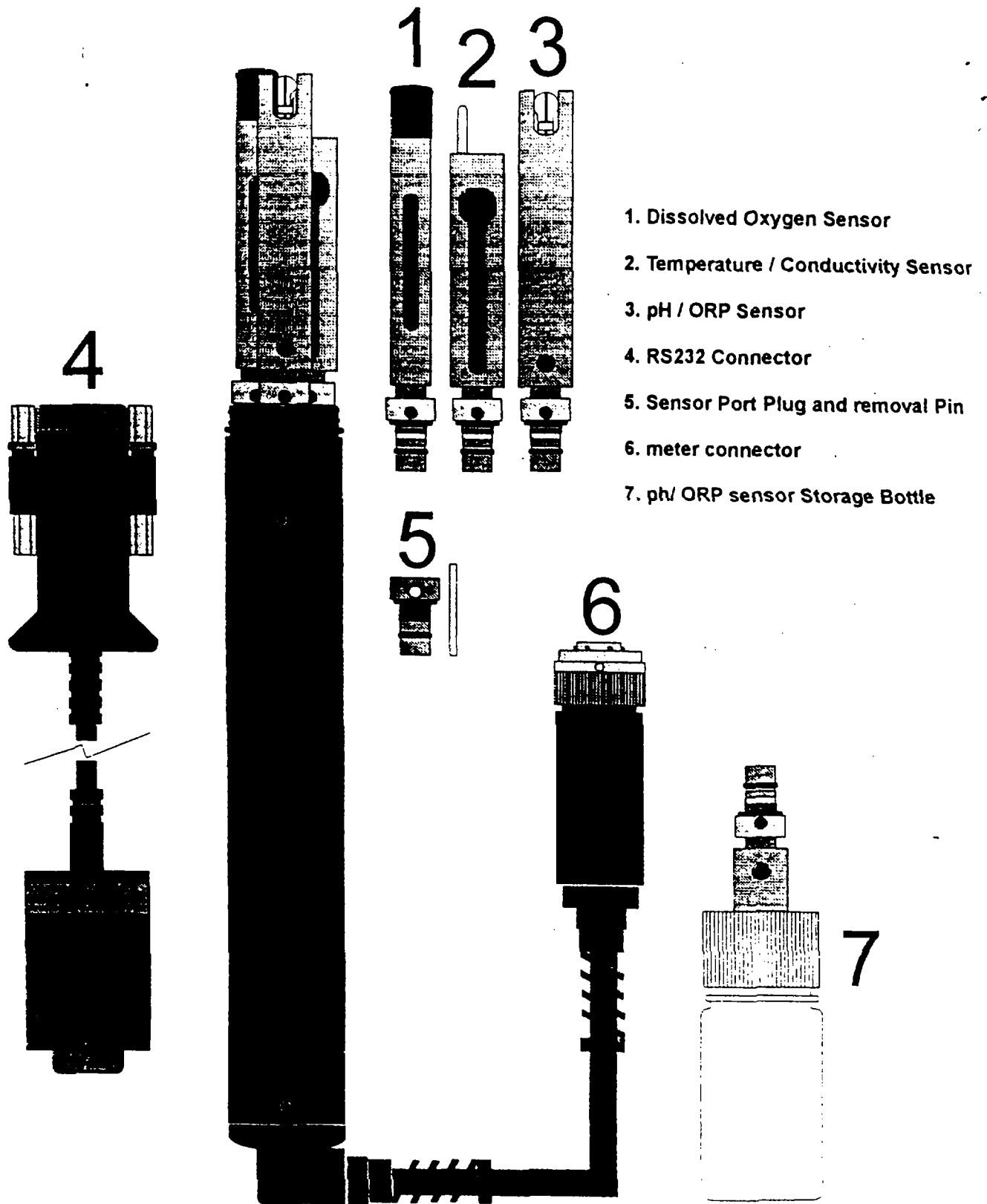


FIGURE 1

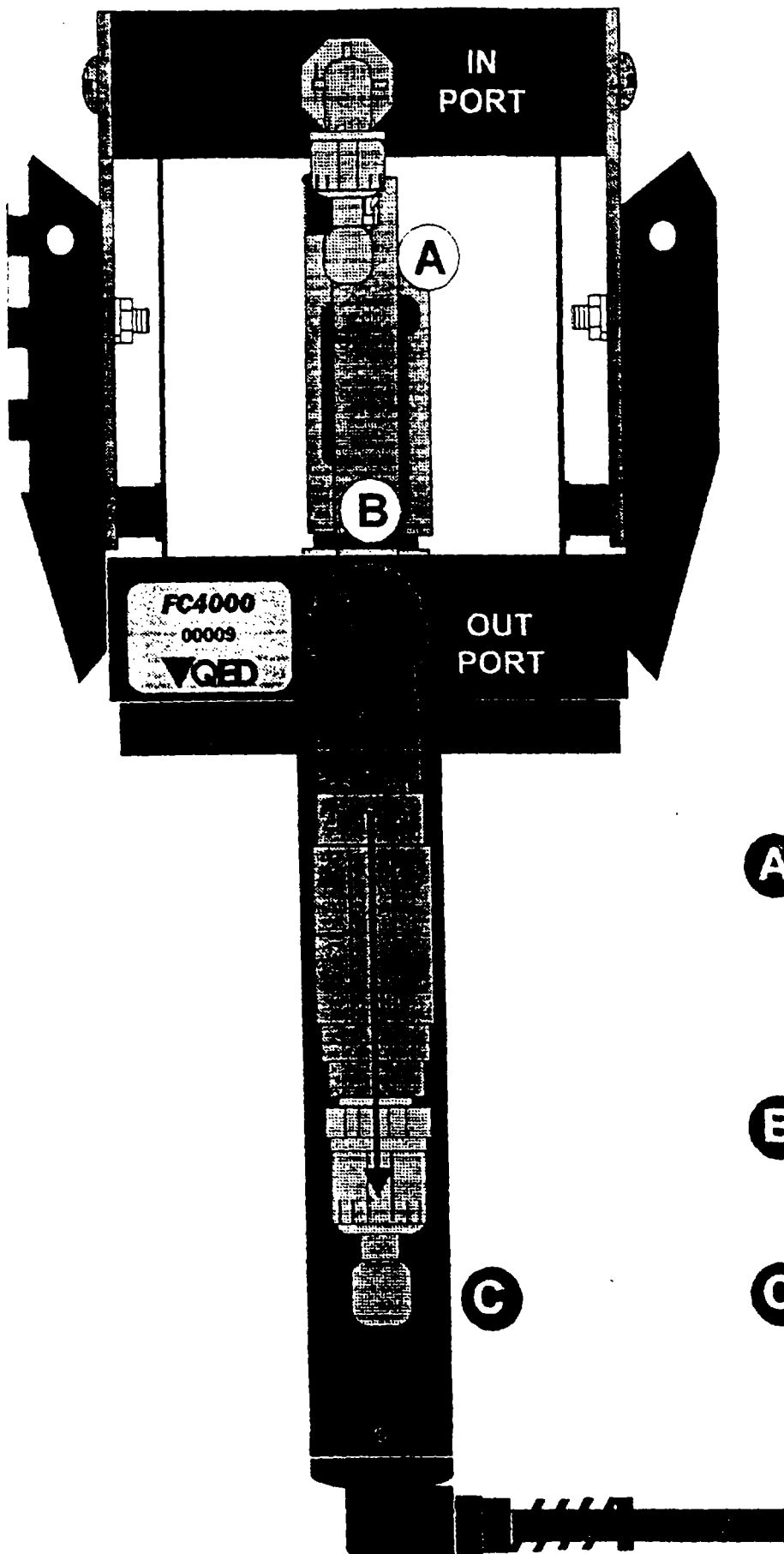


# FC4000 Water Analyzer METER



FIGURE 2

# FC4000 Water Analyzer FLOW CELL



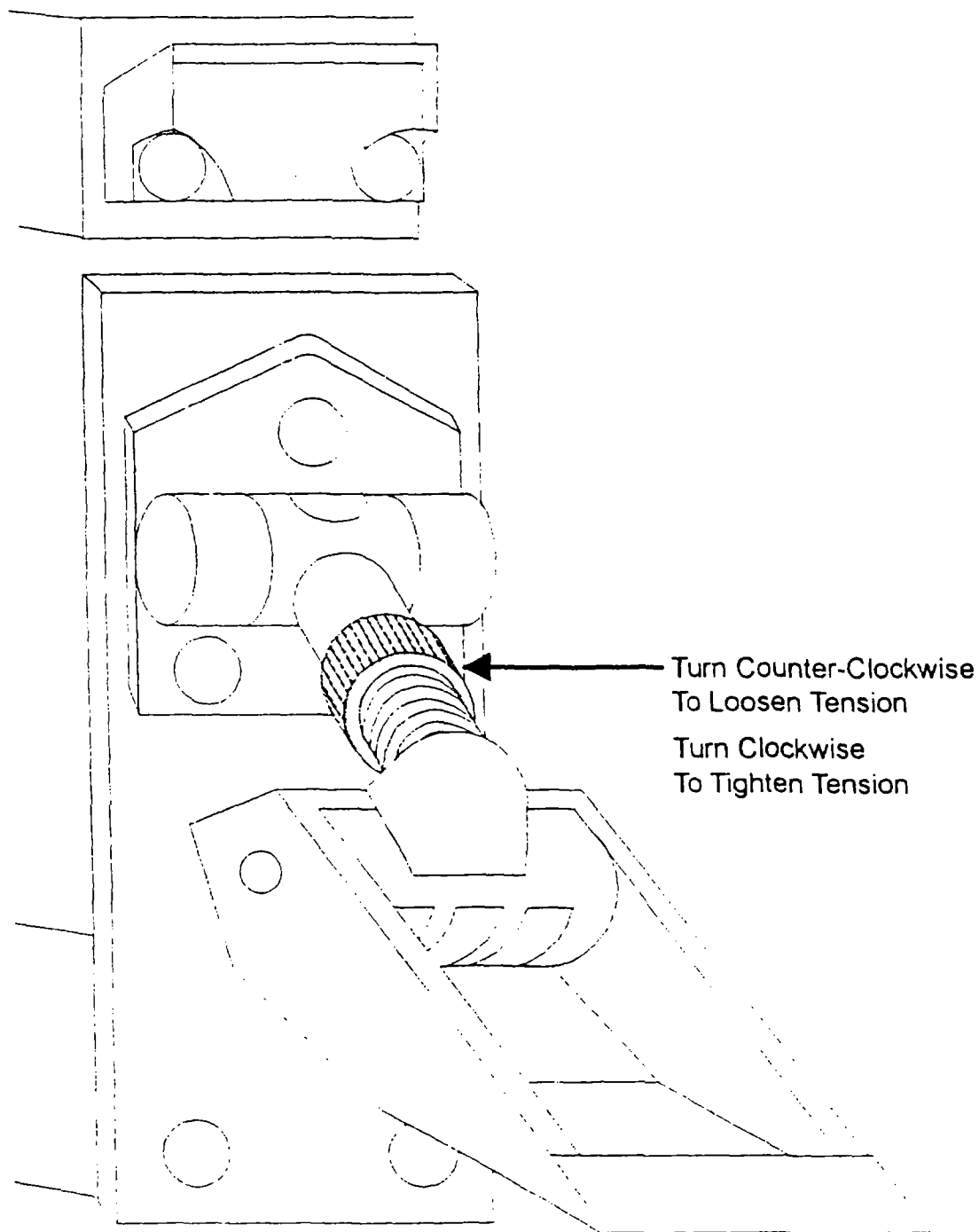
FOR YOUR EASE OF USE  
IT IS NOT NECESSARY  
TO REMOVE THE FLOW  
CELL FROM THE CASE IN  
WHICH IT COMES.

- A** CELL "IN" PORT--ATTACH 3/8" O.D. TUBING TO THIS PORT. ATTACH OTHER END OF TUBING TO THE PUMP DISCHARGE ADAPTER, (PROVIDED).
- B** CELL SONDE--WHERE WATER MEASUREMENTS ARE READ.
- C** CELL "OUT" PORT--PLACE 1/2" O.D. TUBING FROM THIS PORT INTO YOUR COLLECTION VESSEL.

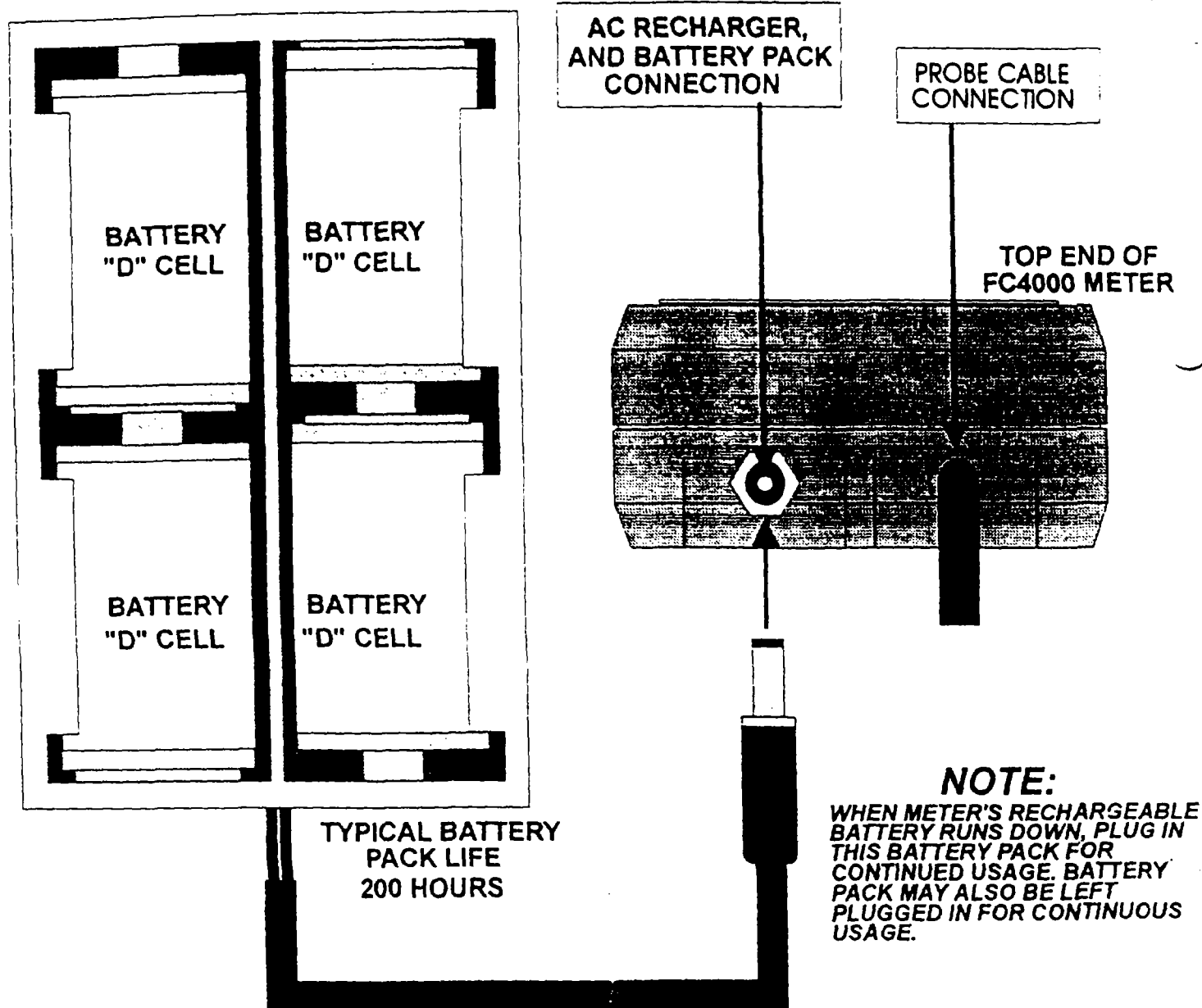
# **FC4000 Water Analyzer**

## **Tightening or Loosening Flow Cell Ear Clamp Tension**

In the event you should notice any air infiltration in the flow cell, or if any leak occurs around the upper or lower O-rings the problem may be solved by tightening the tension of the ear clamp so that it makes a tighter seal.



# FC4000 Water Analyzer Battery Pack



THE BATTERY PACK IS LOCATED BENEATH THE PURGE SAVER METER IN THE UNIT'S CASE. THE BATTERY PACK RUNS OFF 8 ALKALINE "D" CELL BATTERIES. THE BATTERY PACK PLUGS INTO THE PURGE SAVER AS SHOWN.

## CONNECTIONS FOR USE UP TO 2 GPM FLOW RATE

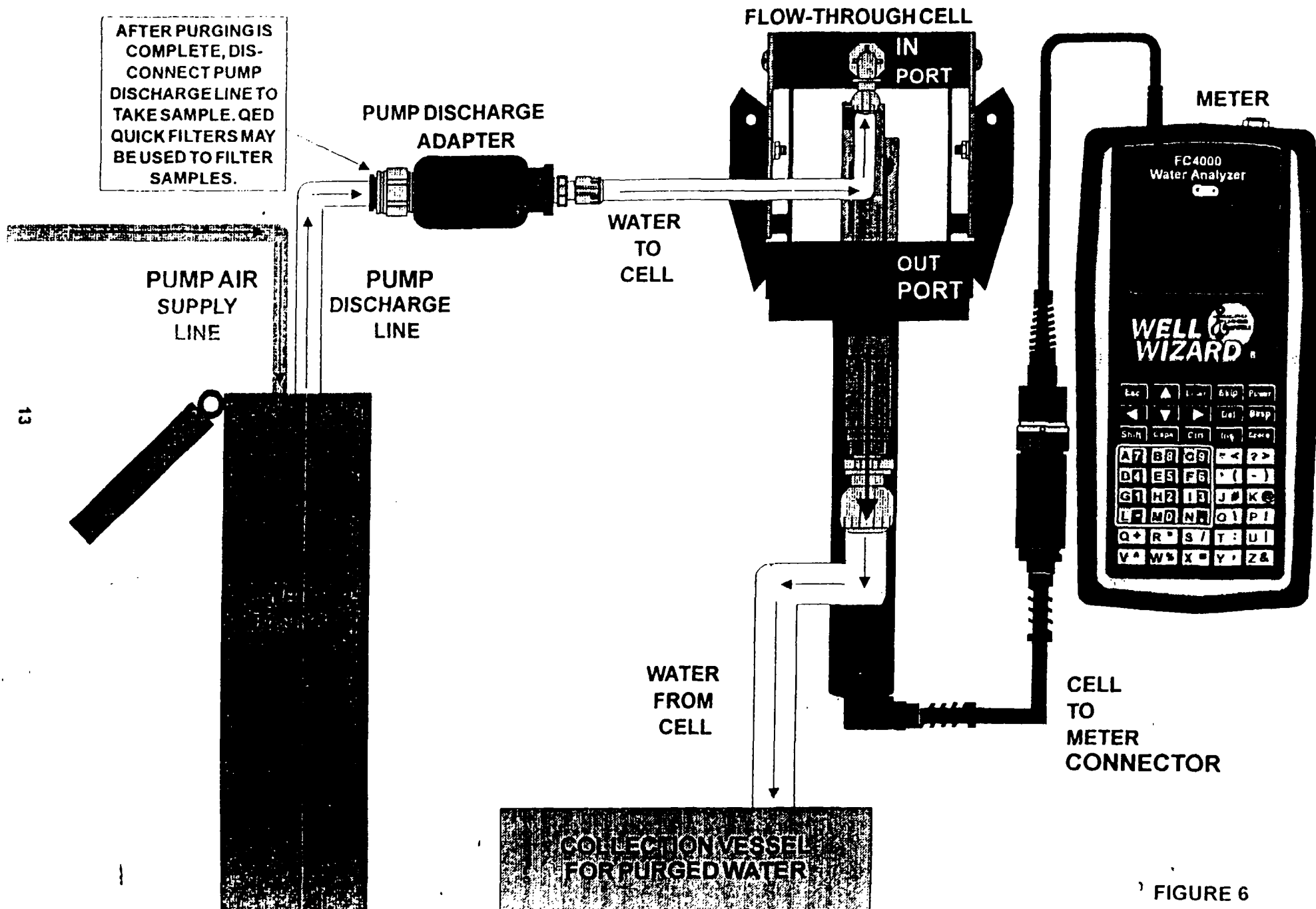


FIGURE 6

# CEI STANDARD OPERATING PROCEDURES

## Chain-of-Custody Procedures

Page 1

SOP # FW-R-003

REVISION DATE: August 28, 1998

**1.0 Scope and Application** - This SOP is intended to outline the general process for completing chain-of-custody forms. Following the chain-of-custody process provides paper trail indicating who was in possession of samples over a period of time.

**2.0 Method Summary** - The chain-of-custody process provides a method of tracking sample possession. If chain-of-custody procedures improperly followed, the validity of the samples can be called into question, particularly in a court of law.

Once collected, all samples should be labeled and maintained at appropriate holding temperatures. A chain-of-custody form should be filled out by the sampler. If custody of the samples is transferred (i.e. to the laboratory), the chain-of-custody form should be signed and dated by the individual receiving custody of the samples.

**3.0 Sample Preservation, Containers, Handling and Storage** - *Not applicable.*

**4.0 Interferences and Potential Problems** - If the proper chain-of-custody procedures are not followed or fully documented, the validity of the samples is called into question. Care should be taken when filling out the chain-of-custody form to ensure it is fully and completely filled out, all dates are correct, and the form is signed by the appropriate sampler.

**5.0 Equipment/Apparatus** - A sample chain-of-custody form is attached for reference.

**6.0 Reagents** - *Not applicable.*

**7.0 Procedure** - Upon sample collection, all samples should be listed on a chain-of-custody. Samples that are not selected for submission to a laboratory for laboratory analysis should be listed on a separate chain-of-custody with "hold for possible analysis" written in the "remarks" area of the form. Prior to transfer, a custody seal will be placed on the sample container.

All chain-of-custody forms should be completed in ink. Any "cross-outs" should be performed with a single stroke through the error and should be initialed and dated by the individual making the correction. The general steps for filling out the chain-of-custody forms are as follows:

1. Fill in the Project Number and Project Name in the appropriate boxes.
2. The sampler should sign the signature box.
3. The sample number, date and time should be filled out and "comp" or "grab" should be checked to indicate if the sample was a composite or grab sample, respectively.
4. The sample description should be filled out to include a description of the sample matrix (i.e., soil or ground water). Additional description can be provided (i.e., sample depth, location, etc.).
5. The number of containers should be recorded. This number should reflect the total number of containers collected for that unique sample number.
6. The analysis should be written in the "analysis desired" area. A check mark should be placed in the column beneath each specified analysis to indicate which samples should be analyzed for that particular analysis. The analysis should be specific to avoid confusion and misunderstandings with the laboratory (i.e., "total RCRA metals" should be written instead of "metals").
7. Any remarks corresponding to a particular sample can be listed in the remarks column on the far left.
8. Any special communication to the laboratory should be written in the remarks box on the lower right portion of the form.

# CEI STANDARD OPERATING PROCEDURES

## *Chain-of-Custody Procedures*

Page 2

- 
9. When the custody of the samples is transferred, the sampler that signed the form should also sign the form in the box that says "relinquished by". Whomever received the samples should sign the corresponding "received by" box and fill in the date and time.
  10. The sampler that relinquished custody should retain the bottom (pink) portion of the form. This form should be maintained with the project files. The remaining two copies of the form should accompany the samples.
  11. Any subsequent transfer of the samples should continue to be documented on the chain-of-custody form.
  12. Upon receipt of the samples at the accredited laboratory, the laboratory identification numbers should be added to the chain-of-custody form. A copy of the final chain-of-custody form should be returned to CEI as part of the laboratory analytical report.

**8.0 Calculations** - *Not applicable.*

**9.0 Quality Assurance/Quality Control** - Project Managers should review the chain-of-custody forms on a regular basis. CEI's QA Manager should occasionally "spot-check" chain-of-custody forms to ensure that the procedures outlined in this SOP are being followed.

**10.0 Data Validation** - *Not applicable.*

**11.0 Health and Safety** - *Not applicable.*

**12.0 References** - *Not applicable.*

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CEI

# CHAIN-OF-CUSTODY RECORD

No. 8724

CARLSON ENVIRONMENTAL, INC.

312 W. Randolph St.

Chicago, IL 60606

(312) 346-2140

PROJ. NO.

PROJECT NAME

SAMPLERS: (Signature)

NUMBER  
OF CONTAINERS

ANALYSIS DESIRED  
(INDICATE  
SEPARATE  
CONTAINERS)

ITEM NO.	SAMPLE NUMBER	DATE	TIME	COMP	GRAB	SAMPLE DESCRIPTION (INCLUDE MATRIX AND POINT OF SAMPLE)	REMARKS
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Relinquished by (Signature)

Date/Time

Received by (Signature)

REMARKS

Relinquished by (Signature)

Date/Time

Received by (Signature)

Relinquished by (Signature)

Date/Time

Received for Laboratory by  
(Signature)



**EAGLE P FICHER**ENVIRONMENTAL SCIENCE  
& TECHNOLOGY DEPT.  
200 W. J. TUNNELL BLVD. MIAMI, OK 74354  
1-800-331-7425Specially Cleaned  
Sample Container

Lot #:

DATE:

TIME:

COLLECTED  
BY:SAMPLING  
SITE:

SAMPLE TYPE:

☐ Grab ☐ Composite ☐ Other

TESTS REQUIRED:

PRESERVATIVE

**CUSTODY SEAL**

Person Collecting Sample \_\_\_\_\_

(signature)

Sample No. \_\_\_\_\_

Date Collected \_\_\_\_\_

Time Collected \_\_\_\_\_

# CEI STANDARD OPERATING PROCEDURES

## *Data Validation*

Page 1

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SOP # FW-Q-001

REVISION DATE: June 1, 1999

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**1.0 Scope and Application** - The purpose of this SOP is to provide guidance to the designated Quality Assurance (QA) Manager. The QA Manager is assigned the task of validating field and laboratory data for a specified project, in accordance with this SOP and the project-specific Quality Assurance Project Plan (QAPP).

In general, the QA Manager should validate at least 20% of the field and laboratory data. The QA Manager should document and report any inconsistencies or errors to the Project Manager.

**2.0 Method Summary** - The data validation process is intended to ensure the precision and accuracy of the data collected during the field work activities, and of the results reported by the analytical laboratory.

The general process to be employed entails cross-referencing field notes with the site-specific work plan to confirm the correct parameters are being retrieved and recorded by the field work team (i.e., log books, boring logs, well logs, etc.). The chain-of-custody forms should be compared to the field notes to confirm consistency in sample identifications, collection times and collections dates.

Once the laboratory data is received, the QA Manager shall review the laboratory results with respect to the chain-of-custody forms to confirm completeness, in terms of the laboratory report. The laboratory spike recovery should be reviewed to confirm it falls within an acceptable range in order to confirm the accuracy of the laboratory data. Results for field duplicates and MS/MSD samples will be reviewed to confirm the precision of the laboratory data.

During the preparation of the final written report, the QA Manager will review the report and supporting data (i.e., tables, figures, etc.) for transcription errors and inconsistencies.

**3.0 Sample Preservation, Containers, Handling and Storage** - *Not applicable.*

**4.0 Interferences and Potential Problems** - If inconsistencies or errors are noted during a review of the field data, the QA Manager will document the inconsistencies or errors on the Quality Control Certification Form (refer to attached form). In addition, the QA Manager will inform the Project Manager who will immediately correct the field work data collection activities (if still on-going) and/or determine if the field activities need to be repeated.

Upon review of the laboratory data, the QA Manager will notify the Project Manager and the Laboratory QA Manager of any inconsistencies, imprecision or inaccuracy of the reported data. All communication should be documented by the CEI QA Manager.

If transcription errors or inconsistencies are detected during a review of the written report, the QA Manager should notify the Project Manager so the report can be corrected prior to its being issued.

**5.0 Equipment/Apparatus** - The QA Manager will document his/her review of the field and laboratory data on the attached Quality Control Certification Form.

**6.0 Reagents** - *Not applicable.*

**7.0 Procedure** -

**Review of Field Data** - The QA Manager will review the field data from at least 20% of the major field activities. Specifically, the QA Manager should review:

- Field log book
- Boring logs
- Well Construction logs
- Chain-of-custody forms
- Survey data and tabulations
- Field maps and distance measurements
- Water level measurements
- Field monitoring logs
- Documentation of changes in PPE

# CEI STANDARD OPERATING PROCEDURES

## *Data Validation*

Page 2

- Documentation of modifications to the work plan or Site Health and Safety Plan
- Any other field notes related to data collection

### Laboratory Data

The QA Manager should review at least 20% of the laboratory data. The review should include:

- An comparison of the chain-of-custody to the laboratory report to confirm consistency and completeness in reporting.
- A review of the percent recovery and the relative percent difference to confirm the laboratory's accuracy.
- A review of the field duplicate sample results to check for precision.
- A review of the field and trip blank sample results to determine if possible field or laboratory contamination may be present.

### Report Preparation

The QA Manager shall review the final written report and supporting documents (i.e., figures, tables, etc.) for consistency and transcription errors.

### Documentation

All reviews conducted by the QA Manager will be documented on the attached Quality Control Certification Form. Any issues with CEI data should be addressed with the CEI Project Manager. Any issues with the laboratory data should be brought to the attention of the CEI Project Manager and addressed with the Laboratory QA Manager.

**8.0 Calculations** - The QA Manager will review the laboratory's calculations of the percent recovery (%R) and the relative percent difference (RPD) between the spike and spike duplicate to confirm sample accuracy.

$$\%R = (\text{Amount in Spiked Sample} - \text{Amount in Sample}) * 100 / (\text{Known Amount Added})$$

$$RPD = [(\text{Amount in Spike1} - \text{Amount in Spike2}) * 100] / [0.5 * (\text{Amount in Spike1} + \text{Amount in Spike2})]$$

**9.0 Quality Assurance/ Quality Control** - *Not applicable.*

**10.0 Data Validation** - *Not applicable.*

**11.0 Health and Safety** - *Not applicable.*

### **12.0 References** -

*Region 5 Superfund Model Quality Assurance Project Plan*, Revision 1, May 1996.

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## Quality Control Certification Form

Project Number	9566D	Date Submitted	
Project Name	Fansteel - North Chicago	Date Due	
Project Manager	Margaret Karolyi		
QA Manager	Valerie Baxa		
Other Reviewer			
Document Type:			
Document Title:			
Items Reviewed:			
Comments:			
Required Actions:			

***The above items have been reviewed and appropriate actions completed.***

\_\_\_\_\_  
Reviewer's Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Project Manager's Signature

\_\_\_\_\_  
Date